State of California
THE RESOURCES AGENCY
Department of Water Resources

BULLETIN No. 80-2

RECLAMATION OF WATER FROM WASTES: COASTAL SAN DIEGO COUNTY

Preliminary Edition

FEBRUARY 1966

HUGO FISHER
Administrator
The Resources Agency

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Director
Department of Water Resources

State of California

THE RESOURCES AGENCY

Department of Water Resources

BULLETIN No. 80-2

RECLAMATION OF WATER FROM WASTES: COASTAL SAN DIEGO COUNTY

Preliminary Edition

FEBRUARY 1966

HUGO FISHER
Administrator
The Resources Agency

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Director
Department of Water Resources

TABLE OF CONTENTS

Page

Page

CHAPTER V. WASTE WATER RECLAMATION PROJECTS . . . 53

ILLUSTRATIONS

FIGURES

TABLES

APPENDIXES

PLATES
(Bound in back of report)

DEPARTMENT OF WATER RESOURCES
.O. BOX 388
ACRAMENTO

November 24, 1965

Honorable Edmund G. Brown, Governor, and
Members of the Legislature of the
State of California

Gentlemen:

Bulletin No. 80-2, "Reclamation of Water from Wastes: Coastal San Diego County", is the second in a series of investigations undertaken by the Department of Water Resources in accordance with Section 230 of the State Water Code to determine the feasibility of reclaiming waste water for beneficial uses in specific areas of the State. The first report in this series was "Feasibility of Reclamation of Water from Wastes in Los Angeles Metropolitan Area", Bulletin No. 80.

Waste water reclamation and statistics on potentially reclaimable ocean discharges of waste water in coastal San Diego County (as well as the State in general) were presented to the Legislature and the State and regional water quality control boards in four progress reports, published in December 1952, June 1954, January 1958, and October 1963 under the title "Reclamation of Water from Sewage or Industrial Waste".

The investigation reported in this bulletin found that coastal San Diego County -- which is currently importing 85 percent of its water supply -- is now discharging to the ocean approximately 40 million gallons per day of waste water that could be reclaimed for certain beneficial uses. Costs of reclamation would be competitive with those of fresh water. In a few cases, such reclamation already is being successfully carried out.

Sincerely yours,

William E. Warne

William E. Warne
Director

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

EDMUND G. BROWN, Governor
HUGO FISHER, Administrator, The Resources Agency
WILLIAM E. WARNE, Director, Department of Water Resources
ALFRED R. GOLZE', Chief Engineer

AREA MANAGEMENT

John R. Teerink . . . . Assistant Chief Engineer

---

SOUTHERN DISTRICT

James J. Doody . . . . District Engineer
Jack J. Coe* . . . . Chief, Planning Branch

This investigation was conducted and
report prepared under the direction of

Mitchell L. Gould** . . . . Chief, Water Quality Section

Prepared under the supervision of

George P. Gribkoff . . . . Senior Engineer, Water Resources
Richard E. Angelos . . . . Senior Engineer, Water Resources

by

Robert L. Wortman . . . . Associate Engineer, Water Resources
Kenneth J. Nixt . . . . Associate Engineer, Water Resources

assisted by

Gary A. Boulier . . . . Assistant Civil Engineer
John M. McGill . . . . Assistant Civil Engineer
M. Blaine Palm . . . . Assistant Civil Engineer
Walter J. Paltz . . . . Junior Civil Engineer

---

*Herbert W. Greydanus was Chief, Planning Branch, until July 1, 1964.
**David B. Willets was Chief, Water Quality Section, until May 20, 1964.

CALIFORNIA WATER COMMISSION

RALPH M. BRODY, Chairman, Fresno

WILLIAM H. JENNINGS, Vice Chairman, La Mesa

JOHN W. BRYANT, Riverside

JOHN P. BUNKER, Gustine

IRA J. CHRISMAN, Visalia

JOHN J. KING, Petaluma

EDWIN KOSTER, Grass Valley

NORRIS POULSON, La Jolla

MARION R. WALKER, Ventura

- - - - 0 - - - -

WILLIAM M. CARAH

Executive Secretary

ORVILLE ABBOTT

Engineer

AUTHORIZATION

Investigations of reclamation of water from sewage and industrial waste are authorized by Section 230 of the California Water Code, which reads as follows:

> "230. The department, either independently or in cooperation with any person or any county, State, Federal, or other agency, to the extent funds are allocated therefor, shall conduct surveys and investigations relating to the reclamation of water from sewage or industrial wastes for beneficial purposes, including but not limited to the determination of quantities of such water presently wasted, and possibilities of use of such water for recharge of underground storage or for agricultural or industrial uses; and shall report to the Legislature and to the appropriate regional water pollution control board thereon, . . . "

This investigation was conducted and the report prepared pursuant to the foregoing authorization.

ACKNOWLEDGMENT

Contribution of information and data used in this investigation from various agencies located in the County of San Diego is gratefully acknowledged.

Special mention is made of the helpful cooperation of the following:

City of San Diego, Utilities Department

San Diego County Department of Public Works

San Diego Regional Water Quality Control Board

ABSTRACT

The Coastal San Diego County waste water reclamation study was undertaken to supply detailed information pertaining to the reclamation of water from wastes in that area. This information includes the quantity of reclaimable water, beneficial uses of this water, and cost of producing reclaimed water from wastes. The study was authorized under Section 230 of the California Water Code.

Four phases were undertaken in carrying out the investigation. These were: (1) an estimation of present and future water requirements; (2) a survey of waste water discharging agencies and the determination of the quantity and quality of waste water available for reclamation; (3) determination of the portion of the water requirements that may be satisfied by reclaimed waste water; and (4) a study of plans to implement the use of waste water.

It was determined that about 53 million gallons per day of waste water effluent in Coastal San Diego County, or 74 percent of the total effluent, is reclaimable for beneficial uses. A portion of this reclaimable waste water is already either directly or indirectly reclaimed, primarily for irrigation, recreational lakes, and ground water recharge.

At present, approximately 40 million gallons per day of waste water that is rated as reclaimable for at least some beneficial uses is being discharged to the ocean. This amounts to 74 percent of the total waste discharge to the ocean in San Diego County. Plans to use some of this waste water were considered for four sites -- the El Cajon-La Mesa, Mission Gorge, Rose Canyon, and Spring Valley areas. Costs of producing reclaimable water for irrigation or other uses at the plant site were estimated to vary from $11 to $65 per acre-foot.

CHAPTER I. INTRODUCTION

The water shortage that has plagued much of Southern California in recent years is the most severe in coastal San Diego County. This has been caused by water demands arising from the unprecedented population increases and industrial growth of the area. As local sources of water have been almost fully developed, it has been necessary to meet the ever-increasing demand with imported water. This imported water now comprises about 85 percent of the total supply. Costs of imported water are rising and will increase significantly when water from Northern California is introduced. Therefore, the use of reclaimed water from wastes in this area should be considered as a means for supplementing imported and local supplies.

In California, conservation of existing resources and development of new water supply sources are economic necessities. In 1949, the California Legislature, recognizing the importance of developing all existing and new sources of water throughout the State, added Section 230 to the California Water Code authorizing the Department of Water Resources to investigate the feasibility of reclaiming water from domestic or industrial wastes for beneficial purposes. Waste waters discharged to tidal waters are considered lost for beneficial uses. Thus, the reclamation of such waters can be considered a potential new source of supply and, in this respect, may be included as part of The California Water Plan.

In carrying out the directive of the Legislature, the Department undertook a series of investigations. One phase of the work involved an overall look at the feasibility of reclaiming waste waters in the State.

Results of this work were reported in four progress reports published under the title "Reclamation of Water from Sewage or Industrial Waste" (December 1952 and June 1954 and as Bulletin No. 68 in January 1958 and Bulletin No. 68-62 in October 1963).[6,7,10,14]*

A second group of investigations was designed to explore in detail the feasibility of such reclamation in specific areas. The first of these studies was reported in Bulletin No. 80, "Feasibility of Reclamation of Water from Wastes in the Los Angeles Metropolitan Area"[13], published in December 1961. This report, "Reclamation of Water from Wastes in Coastal San Diego County", as Bulletin No. 80-2 is the second in this series.

Objective of Investigation

The general objective of this investigation is to ascertain the quantity and cost of water that can be made available through waste water reclamation to meet future supplemental water requirements for beneficial uses in coastal San Diego County.

Attaining this objective required the determination of:

1. Water requirements of the area and the need for a supplemental supply.
2. Quantity and quality of water that can be reclaimed from waste water now being discharged to the ocean.
3. Beneficial uses for reclaimed water.
4. Costs of reclaimed water.

Area of Investigation

The area of this investigation, coastal San Diego County, is shown on Plate 1, "Location Map".

---

*Numbers in parentheses indicate references listed in Appendix A.

Coastal San Diego County comprises approximately 2,950 square miles of land area which drains from the crest of the Peninsular Mountains west to the Pacific Ocean. The principal streams that drain the study area are the Santa Margarita, San Luis Rey, San Dieguito, San Diego, Sweetwater, Otay, and Tia Juana Rivers.

Topographically, the study area consists of three belts, or zones, of land. The first, or coastal plain, zone includes gently rolling hills and coastal plains comprising a 10-mile wide strip along the Pacific Ocean. The second, or foothill-valley, zone is characterized by narrow valleys enclosed by ranges of hills extending inland an additional 10 to 15 miles. The third, or mountain, zone includes the Peninsular Mountain Range, which rises gradually to a crest elevation of more than 6,000 feet 40 to 60 miles inland.

The climate in coastal San Diego County is generally mild with relatively light precipitation, most of which is in the form of rainfall. Proceeding inland, as elevations increase, temperature variations become wider and precipitation becomes greater. Mean seasonal precipitation is approximately 10 inches near the coast and more than 40 inches at the highest elevations in the Peninsular Mountain Range. Precipitation occurs principally in the winter, with about 90 percent of the seasonal total generally occurring from November through April.

Agriculture in the study area is well developed and stable. The main crops are avocados, citrus fruits, and truck crops.

The principal city in the County is San Diego, a major west coast harbor of approximately 575,000 persons. Its location makes it a gateway to Mexico for the large numbers of tourists who visit the area each year. A number of smaller cities and towns also occupy the study area, the largest of which border the City of San Diego.

The Eleventh Naval District has its headquarters in the City of San Diego together with the attendant operational, training, and supply facilities. Camp Pendleton, a U. S. Marine Corps training camp, occupies a large area of the north coastal area near Oceanside.

Aircraft, electronic, and light manufacturing are heavily concentrated in and around the San Diego metropolitan area. Retirement communities and recreational facilities such as golf courses, beaches, and park areas abound in the study area.

Conduct of Investigation

This investigation was completed in four phases. The initial phase consisted of a determination of present and future water requirements. The second phase was a survey of waste water discharging agencies in the study area and the determination of the quantity and quality of waste water available for reclamation. During the third phase, the portion of the demand for supplemental water that could be supplied by reclaimed waste water was determined. In the final phase, plans were developed to implement the use of waste water supplies. Locations for potential waste water reclamation plants were selected on the basis of an adequate supply of reclaimable water and an adequate demand for this water. Finally, capital costs for the selected reclamation plants were derived.

To facilitate the investigation of the study area, coastal San Diego County was divided into three subareas. The three subareas are the San Diego metropolitan subarea, the San Diego County subarea, and the Camp Pendleton subarea. They are shown on Plate 1.

In carrying out the investigation, data were collected from local, state, and federal agencies throughout coastal San Diego County. This entailed collecting samples of waste discharges and interviewing representatives of each of the discharging agencies, the Eleventh Naval District, the Chambers of Commerce in the various municipalities, and the San Diego Regional Water Quality Control Board and other groups interested in waste water reclamation. In addition, a study was made of the literature pertaining to waste water reclamation and to coastal San Diego County. Also, department records on ground water, surface water, land use, and other conditions in the study area were reviewed.

Prior Investigations and Reports

Published reports of major investigations into reclamation of waste water conducted within the coastal San Diego County area are:

Boyle Engineering, Consulting Engineers. "City of San Diego Water Reclamation Study for Balboa Park and Mission Bay Park". March 1963.

Caldwell, David H.; Hyde, Charles Gilman; and Rawn, A M "Report on the Collection, Treatment and Disposal of the Sewage of San Diego County, California". September 1952.

Department of Public Works, San Diego County, California. "Annual Report of the County Sanitation Districts, Fiscal Year 1961-62".

Holmes and Narver-Montgomery. "Basic Plan for the Collection, Treatment and Disposal of Sewage, for the Metropolitan Area, San Diego, California". November 1958.

Rawn, A M; McKee, Jack Edward and Vincenz, Jean L. "North Coastal San Diego County Sewerage Survey". June 1960.

CHAPTER II. WATER REQUIREMENTS AND SUPPLY

Early in the nineteenth century, the mission fathers built the first masonry dam in Mission Gorge to conserve water for irrigation of valley lands surrounding the San Diego Mission. Since then, local water sources in coastal San Diego County have been used extensively and are approaching ultimate development. A major source since 1947 has been the Colorado River, now supplying approximately 85 percent of the total demand.

Several factors have contributed to the increased dependence on imported water. The most critical factor has been the population growth in San Diego County. Another major factor has been the depletion of ground waters in coastal areas to supply the increased demand. The County has recently suffered the longest dry spell in history. This lack of precipitation has resulted in greatly reduced runoff; many reservoirs designed to impound water for public supply have been dry or nearly dry for several years.

Additional sources of water being developed to meet the increasing demand include waste water reclamation* and sea-water conversion(29)**. These efforts will probably be accelerated in the near future.

To give an idea of water conditions and the potential of waste water reclamation in San Diego County, this chapter first explores the water requirements--both present and future--and then compares these demands with the local supply and the availability and probable costs of imported supplies.

---

*Definitions of words used in this report are given in Appendix B.
**Numbers in parentheses indicate references listed in Appendix A.

Water Requirements

Water is required for the following beneficial uses in the study area: domestic consumption; commercial use; industrial use; irrigation of agricultural lands, parks, golf courses, and freeway green belts; and ground water replenishment. The estimated total water requirements in the study area up to the year 2000 are presented on Figure 1.

Urban Water Requirements

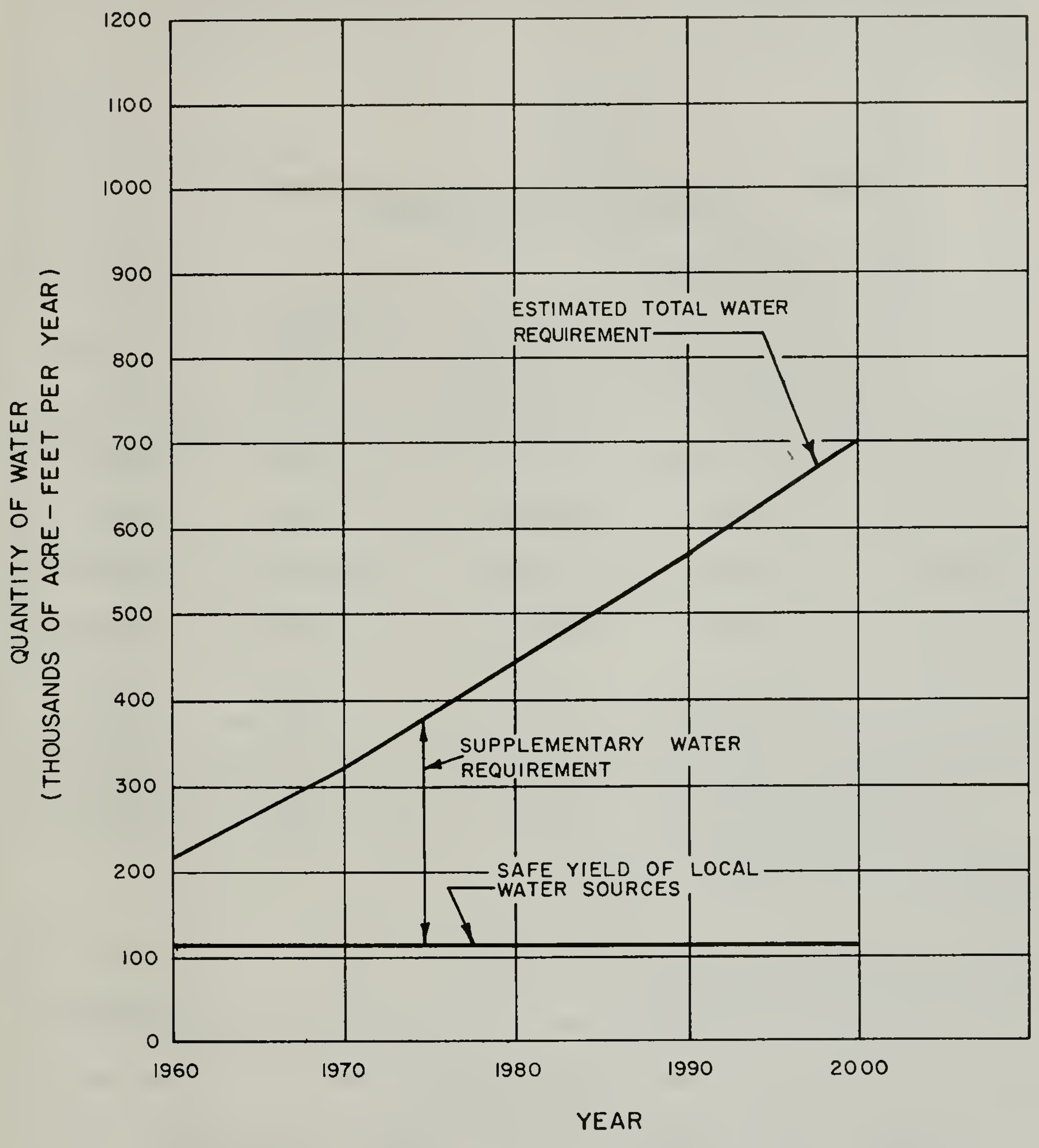
The population of San Diego County has increased nearly fivefold since 1930. This population growth is reflected in the increased industrial activity and agricultural production, and the development of residential and retirement communities. Historical and projected population figures for San Diego County and the subareas are presented in Table 1.

TABLE 1

HISTORICAL AND PROJECTED POPULATION OF SAN DIEGO COUNTY AND SUBAREAS

Year	San Diego County	San Diego metropolitan subarea	San Diego County subarea[a]	Study area
1930[b]	209,659	168,153	41,306	209,459
1940	289,348	241,346	47,702	289,048
1950	556,808	432,975	122,933	555,908
1960	1,033,011	806,437	225,437	1,031,511
1970[c]	1,407,700	1,193,700	211,500	1,405,200
1980	1,800,100	1,513,100	283,500	1,796,600
1990[d]	2,250,000	1,838,000	407,000	2,245,000
2000	2,700,000	2,130,000	563,500	2,693,500

a. Camp Pendleton subarea included. The population of Camp Pendleton was estimated to be 40,000 from 1960 to 2000(8).
b. 1930-1960 populations obtained from U. S. Department of Commerce, Bureau of Census(28).
c. 1970-1980 populations obtained from Department of Finance(3).
d. 1990-2000 populations extrapolated from Department of Finance population statistics(3).



FUTURE WATER REQUIREMENTS AND SUPPLY

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1965

Urban water requirements from the year 1960 to the year 2000 are given in Table 2. By the year 2000, it is expected that the urban water requirements will be 476,750 acre-feet per year. This is derived from the estimated population of 2,693,500 and a unit use of 0.177 acre-foot per capita per year.

TABLE 2

PRESENT AND PROJECTED URBAN WATER REQUIREMENTS
IN COASTAL SAN DIEGO COUNTY

Year	Unit urban water use, in acre-feet per capita per year[a]	Acre-feet		
		San Diego metropolitan subarea	San Diego County subarea[b]	Study area
1960	0.122	98,385	27,459	125,844
1970	0.137	163,537	28,975	192,512
1980	0.150	226,965	42,525	269,490
1990	0.161	295,918	65,527	361,445
2000	0.177	377,010	99,740	476,750

a. Developed for an unpublished letter report from the District Engineer of the Southern District to the Assistant Chief Engineer, Department of Water Resources, dated December 23, 1964, about preliminary estimates of water demand.
b. Camp Pendleton subarea included.

Agricultural Water Requirements

Irrigated agricultural land in 1958 was approximately 63,425 acres. The corresponding agricultural water use was 95,327 acre-feet. Water requirements and acreage for various types of agriculture are presented in Table 3.

TABLE 3

AGRICULTURAL LAND AND WATER USE IN COASTAL SAN DIEGO COUNTY IN 1958*

Crop	Acres	Applied water, in acre-feet per year
Alfalfa	2,690	6,456
Pasture	8,530	20,472
Citrus and subtropical	31,480	44,072
Truck crops	11,430	16,002
Field crops	1,030	1,442
Deciduous fruits and nuts	1,800	3,240
Small Grains	5,710	2,284
Vineyards	755	1,359
TOTAL IRRIGATED AGRICULTURE	63,425	95,327

*Adapted from Department of Water Resources Bulletin No. 102, "San Diego County Land and Water Use Survey, 1958", Tables 4 and 5, page 30.

Water requirements of irrigated agriculture in coastal San Diego County from 1970 to 2000 are presented below. These values were taken from basic data for Bulletin No. 78, Appendix D[12].

Year	Acre-feet
1970	121,400
1980	150,900
1990	200,100
2000	223,400

Based on these data and data in Table 2, approximately 32 percent of the total water required in the year 2000 will be used for irrigated agriculture.

Water Supply

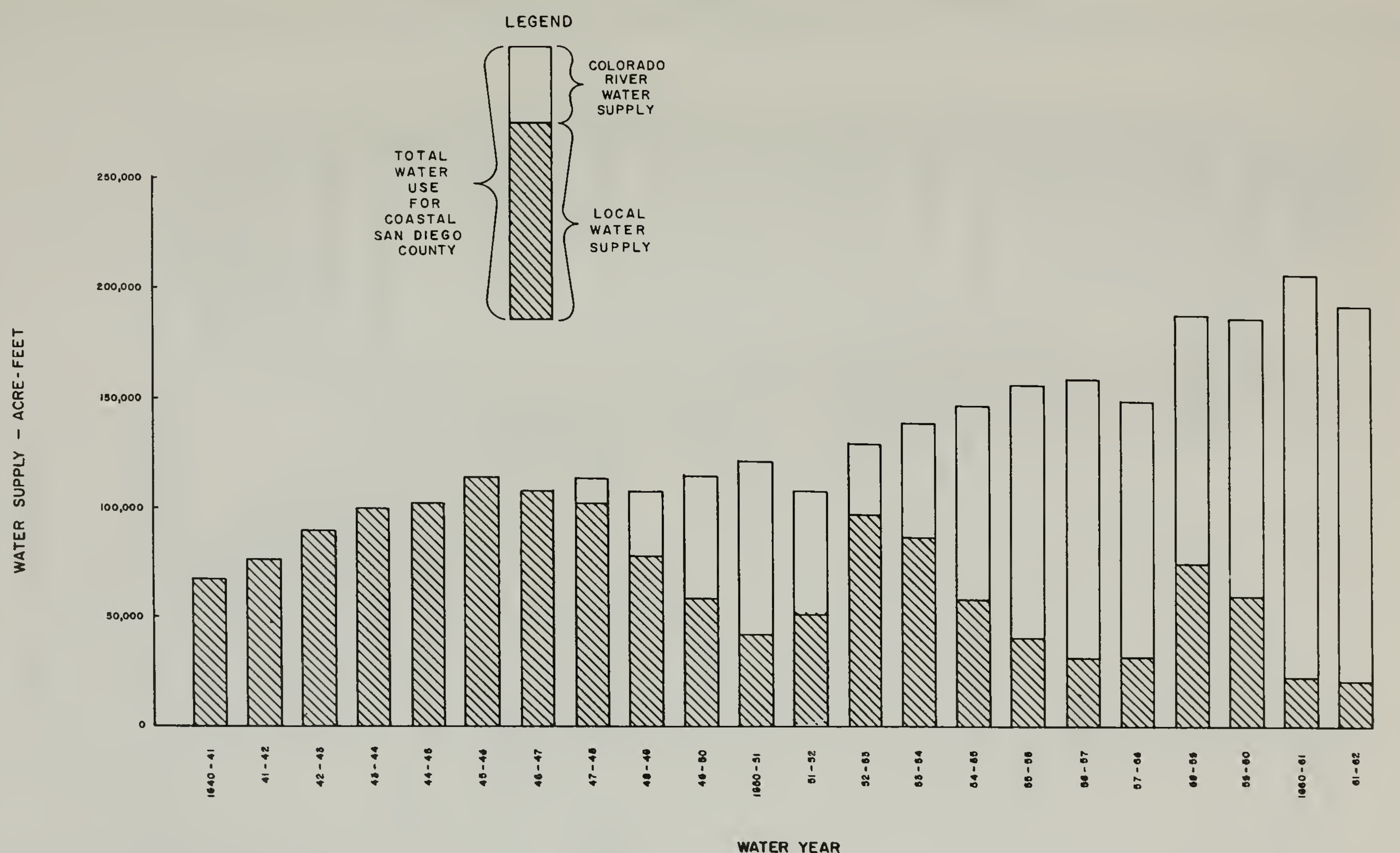
To meet present and future water requirements, a variety of sources have been or will be tapped. The following information on these water sources has been divided into present supply and future supply.

Present Water Supply

The present water supply of coastal San Diego County is derived from the following sources: Colorado River, surface storage, ground water basins, waste water reclamation. A sea-water conversion plant was operated at Point Loma until it was moved to Cuba in 1964, and a new plant is under study. The major water supply facilities in the study area are indicated on Plate 2, "Major Water Supply Facilities and Location of Sampling Wells".

Colorado River Water. The San Diego County Water Authority, a member agency of The Metropolitan Water District of Southern California, was organized in 1944 primarily for importing Colorado River water to San Diego County(24). Authority membership consists of ten municipal water districts, four irrigation districts, four cities, and one public utility district. The Water Authority service area includes about 93 percent of the population and approximately 25 percent of the area of San Diego County. Member agencies supply an estimated 97 percent of the total water demand in San Diego County, of which approximately 85 percent is derived from the Colorado River. Historical quantities of water supplied to the study area are presented on Figures 2 through 4.

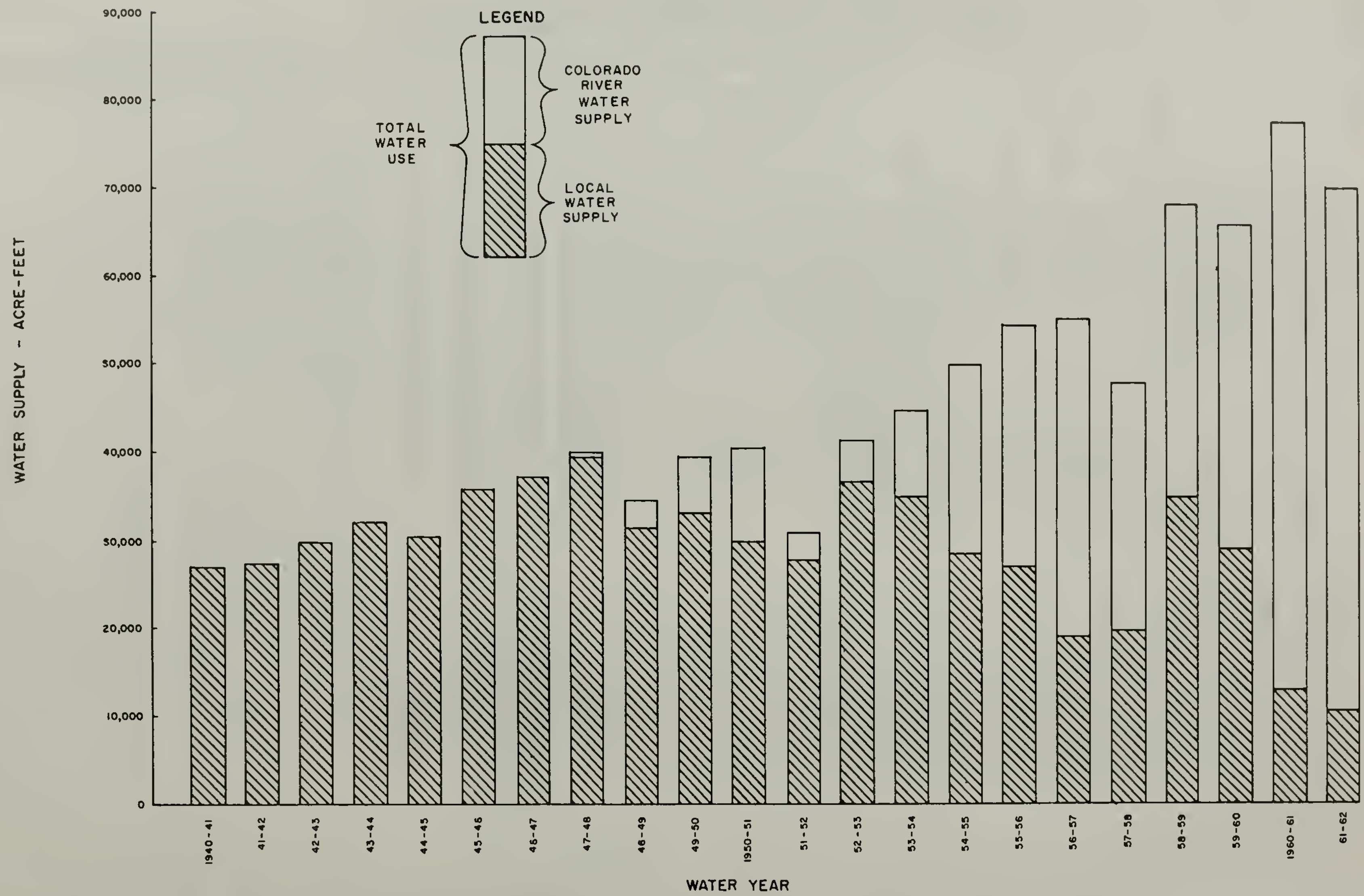
Surface Water. The safe yield of surface storage developments is estimated to be about 66,000 acre-feet per year(9). However, several factors have combined to reduce the actual yield in recent years. Current drought conditions, coupled with unprecedented increases in water demand, have necessitated overdraft of surface reservoirs, and the safe yield cannot presently be met.



NOTE: CAMP PENDLETON SUBAREA NOT INCLUDED

HISTORICAL WATER PRODUCTION WITHIN MEMBER AGENCIES OF THE SAN DIEGO COUNTY WATER AUTHORITY IN COASTAL SAN DIEGO COUNTY

DEPARTMENT OF WATER RESOURCES SOUTHERN DISTRICT, 1965

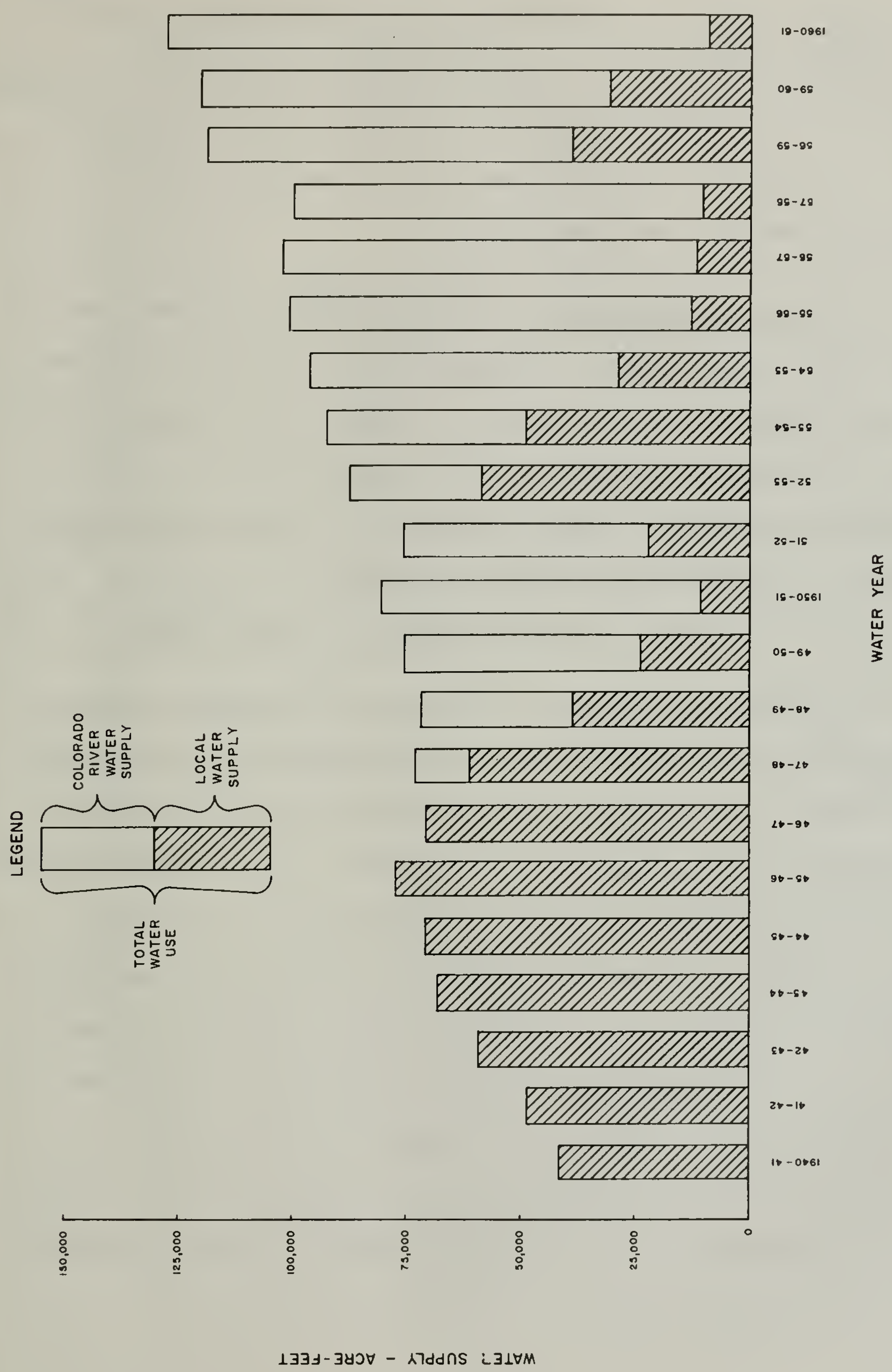


HISTORICAL WATER PRODUCTION WITHIN MEMBER AGENCIES OF THE
SAN DIEGO COUNTY WATER AUTHORITY IN
SAN DIEGO COUNTY SUBAREA

FIGURE 3

DEPARTMENT OF WATER RESOURCES SOUTHERN DISTRICT 1965

FIGURE 4



HISTORICAL WATER PRODUCTION WITHIN MEMBER AGENCIES OF THE SAN DIEGO COUNTY WATER AUTHORITY IN SAN DIEGO METROPOLITAN SUBAREA

DEPARTMENT OF WATER RESOURCES SOUTHERN DISTRICT, 1965

Ground Water. The safe yield of presently developed ground water storage capacity is estimated to be 45,000 acre-feet per year[9]. Ground water basin levels have been lowered in recent years due to drought conditions and overdraft. In addition, sea-water intrusion and other forms of pollution have degraded some of the ground water bodies, rendering them unsuitable for domestic use.

Waste Water Reclamation. Reclaimed water is derived from waste water resulting from domestic and industrial use. Reclaimed water can be used for purposes such as irrigation, thereby releasing water of better quality for domestic consumption. About 14,000 acre-feet per year of waste waters are presently being reclaimed for irrigation, ground water recharge, and decorative and recreational lakes in the study area. This subject will be discussed in greater detail in subsequent chapters.

Sea-Water Conversion. In 1958, the U. S. Congress authorized the Department of the Interior to construct and operate an experimental saline water conversion plant on Point Loma in the City of San Diego. The Department of Water Resources cooperated in this enterprise and contributed more than $800,000, or half the construction costs. This 1,000,000-gallon per day multistage flash distillation plant was placed in operation in November 1961. Since that time, this plant has supplemented the San Diego city water supply with approximately 1,120 acre-feet per year, purchased at a price comparable to that paid for Colorado River water. Estimated actual costs of saline water conversion at this plant are slightly more than $1 per 1,000 gallons, or $325 per acre-foot.

The sea-water conversion plant at Point Loma was dismantled and erected in Cuba in 1964. Plans for a similar but larger installation are being considered.

Future Water Supply

During this century, the future water supply for coastal San Diego County will come from the following sources: The Colorado River, Northern California water, local surface water, local ground water, waste water reclamation, and sea-water conversion. Local and Colorado River water sources have been developed to near ultimate capacity. The need for supplemental water to meet future increases in demand in San Diego County and elsewhere in the State has brought about the development of The California Water Plan and authorization and construction of the State Water Project. Present plans call for the delivery of Northern California water through the state facilities to Riverside County and thence through facilities of The Metropolitan Water District of Southern California to the study area by 1972. At present the major source of supply to the City of San Diego is Colorado River water conveyed to the City through two aqueducts. The purchase of Colorado River water plus payment of taxes to the Metropolitan Water District costs the City of San Diego approximately $50 per acre-foot of water delivered to the City.

A large portion of this future water demand could be supplied at a lower cost through waste water reclamation. The remaining sections of this report are devoted to the discussion of waste water reclamation with respect to quantities of reclaimable wastes; quality of waste flows; and plans, including costs, for the use of reclaimed waste water for lower priority beneficial uses.

CHAPTER III. WASTE WATER QUANTITIES

The total waste water flow in coastal San Diego County in the 1961-62 fiscal year was about 71 million gallons per day (mgd) and, in the 1962-63 fiscal year, about 72 mgd. Of this, approximately 73 percent, (54 mgd) was discharged to the ocean in 1962-63. A major contributor to this figure is the San Diego metropolitan subarea, which now discharges about 58.5 mgd of its waste waters to the ocean.

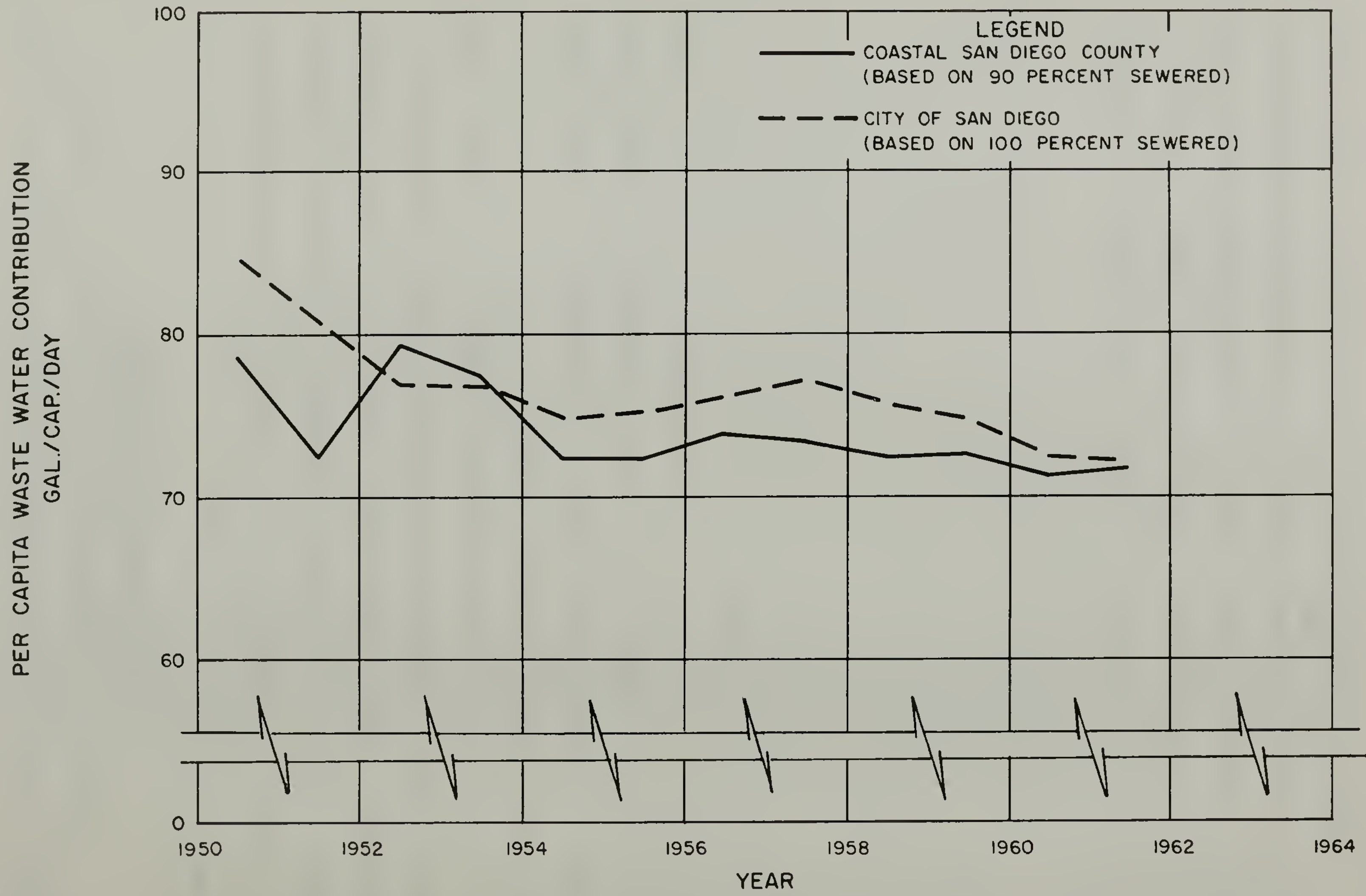
During 1962-63, waste water in the study area consisted of about 72 gallons per capita per day, or approximately 66 percent of the total domestic and industrial water supply. Waste water contributions for coastal San Diego County and the City of San Diego are presented on Figure 5. These contributions were calculated by dividing the waste water flow by the population served by sewerage systems. Waste water flows were taken from flow records obtained from the various waste disposal agencies. In San Diego it is assumed that the entire population is served by sewerage systems. Approximately 90 percent of the population in the coastal county area is served by sewerage systems.

In this report, waste discharge quantities are discussed under the three subareas, the San Diego metropolitan subarea, the San Diego County subarea, and the Camp Pendleton subarea. Waste water treatment facilities, except for the Point Loma plant, are discussed in Appendix C and are indicated on Plates 3A and 3B. Historical discharge quantities of sewage are tabulated in Appendix D.

San Diego Metropolitan Subarea

Disposal of liquid wastes became a function of the City of San Diego in 1885 when the first sewers were built. However, San Diego's

FIGURE 5



PER CAPITA WASTE WATER CONTRIBUTION IN
COASTAL SAN DIEGO COUNTY

first sewage treatment facilities, a 14 mgd treatment plant on Harbor Drive, was put into operation in 1943. In 1948-49, it was enlarged to 40 mgd.

During this period, sewage treatment plants were developed in many surrounding communities to handle increasing waste water flows. Because of the continued explosive growth of the San Diego area, the treatment plants became overloaded. Plant overloading plus the contamination of San Diego Bay from the many discharge outfalls brought a quarantine of the Bay by the State Department of Public Health in 1955.

In 1958, the city council retained engineering services for the design of a sewage collection, treatment, and disposal system for the San Diego metropolitan subarea. At this time, most of the surrounding communities, which had separate treatment facilities, decided that joining a Metropolitan Sewerage System with unified control would be the most economical method of eliminating contamination of San Diego Bay and the shores of the Pacific Ocean. When the Metropolitan System was completed in September 1963, the subarea had 14 major sewage discharges, 2 abandoned secondary treatment plants, and 1 outfall that had been plugged and abandoned. The 14 major discharges were from 4 primary treatment plants, 6 secondary treatment plants, 2 primary-oxidation pond installations, and 2 outfalls that had no treatment except chlorination. On completion of the new system, most of the major discharges were incorporated into the Metropolitan Sewerage System. The other major discharges still in operation are those from the Lakeside Sewage Treatment Plant (secondary), San Ysidro Sewage Treatment Plant (raw sewage lagoon), and Santee Sewage Treatment Plant (secondary). These plants are described in Appendix C.

The new San Diego Metropolitan Sewerage System, which incorporates most of the independent dischargers, now handles approximately 98 percent of the total flow produced in this subarea. The system is composed of a large network of collector and interceptor sewer lines with a single ocean outfall located on Point Loma.

The City of San Diego's Point Loma plant is a primary treatment facility with an ocean outfall. The plant treats and discharges the flow from the Metropolitan Sewerage System, which serves an area of 400 square miles. The plant has a design capacity of 88 mgd and is presently treating about 58.5 mgd. This plant consists of three mechanical bar screens, a raw sewage pumping station, two aerated grit removal tanks, four sedimentation tanks, two primary digesters, and two secondary digesters. The digested sludge is pumped to Mission Bay Park for landfill, and the plant effluent is discharged to the Pacific Ocean.

Some of the major interceptor, or trunk, sewers are listed in Table D-2, Appendix D, along with the flow in mgd and acre-feet per year for each during selected flow periods. The locations of the trunk sewers and the sampling points are shown on Plate 4. In addition, this plate shows the locations of the pumping and metering stations for the San Diego Metropolitan Sewerage System.

The San Diego Metropolitan Sewerage System is designed to meet the needs to the year 2000, for an ultimate capacity of 234 mgd. Each participating agency has reserved a portion of this design capacity to the year 2000. A summary of the apportionments and percent of total capacity for each contributing agency are as shown in Table 4.

TABLE 4

APPORTIONMENT OF SAN DIEGO
METROPOLITAN SEWERAGE SYSTEM[25]

Agency	Capacity service proportion	
	Apportionment mgd	Percent of design capacity
City of Chula Vista	22.2	9.5
City of Coronado	3.0	1.3
City of El Cajon	10.0	4.3
City of Imperial Beach	3.0	1.3
City of San Diego	168.7	72.1
Spring Valley Sanitation District	6.0	2.5
Other participating agencies	21.1	9.0
TOTAL	234.0	100.0

Costs to each participating agency for the disposal of sewage through the Metropolitan Sewerage System consist of a fixed charge for the capital cost of the system plus an operating charge based on the amount of sewage that each agency discharges into the system. Capital costs for the complete system will probably average about $25 per acre-foot of sewage discharged. The operating charge is in the range of $13 to $15 per acre-foot of sewage discharged.

The historical quantities of sewage discharged in the San Diego metropolitan subarea are listed in Table D-1, Appendix D. The quantity of sewage discharged in the metropolitan subarea increased from more than 44 mgd in 1955-56 to more than 59 mgd in 1962-63. The City of San Diego, the principal contributor in this subarea, discharged 91 percent of the total sewage flow in 1955-56 and 81 percent of the total flow in 1962-63.

Variations in the quantities of sewage discharged by some of the sewage treatment plants in the metropolitan subarea are presented on Plate 5.

LOOKING SOUTH ALONG POINT LOMA

The ocean outfall from the sewage treatment plant may be seen in the upper righthand corner.

From the Historical Collection of Title Insurance and Trust Company

San Diego County Subarea

The San Diego County subarea consists of all of coastal San Diego County except the area contained in the metropolitan subarea, the military installations at Camp Pendleton, and the Fallbrook Naval Reservation. In the county subarea are 20 major sewage treatment agencies, which operate 24 treatment plants, consisting of 2 primary treatment facilities, 6 primary and oxidation pond treatment facilities, and 16 secondary treatment facilities. Appendix C describes sewage plant facilities in the San Diego County subarea.

The majority of the plants in the San Diego County subarea were built in the late 1940's under the County Sanitation District Act, and since that time have been greatly expanded. In the late 1940's and early 1950's, the majority of sewage discharges were insignificant, except for those from Oceanside and Escondido. Between 1950 and 1963, several of the other treatment agencies became prominent dischargers. The quantities listed in Table D-3, Appendix D, represent the average daily flow for the major discharges from the 1955-56 through the 1962-63 fiscal years. The total daily flow from the County subarea increased significantly from approximately 2.23 mgd in 1955-56 to approximately 8.95 mgd in 1962-63.

Variations in the quantities of sewage discharged in the County subarea during the 1961-62 fiscal year are presented on Plate 6. Minor variations in discharge occur at Oceanside and the new Escondido Treatment Plants. Major variations occur at the Del Mar, Callan, and old Escondido Treatment Plants.

Camp Pendleton Subarea

The Camp Pendleton subarea consists of two United States Naval establishments -- Camp Pendleton Marine Corps Base and Fallbrook Naval Ammunition Depot. Sewage treatment facilities in this subarea consist of ten treatment plants; nine serve Camp Pendleton, and one serves the Fallbrook Naval installation. Of the ten treatment plants, nine provide secondary treatment and one provides primary treatment with chlorination. The plants are described in Appendix C.

The Camp Pendleton subarea has a total area of 132,310 acres and a total population of 25,928 (1960 census). Annual discharge quantities for the nine operating treatment plants serving Camp Pendleton and the period of record on each discharge are as follows:

Plant No. 1:	901 acre-feet	(10-year average)
Plant No. 2:	742 acre-feet	(10-year average)
Plant No. 3:	489 acre-feet	(18-year average)
Plant No. 8:	260 acre-feet	(8-year average)
Plant No. 9:	303 acre-feet	(9-year average)
Plant No. 10:	156 acre-feet	(8-year average)
Plant No. 11:	295 acre-feet	(9-year average)
Plant No. 12:	349 acre-feet	(7-year average)
Plant No. 13:	345 acre-feet	(8-year average)

Average daily flows from the 1955-56 through the 1962-63 fiscal years for the Camp Pendleton subarea are presented in Table D-4, Appendix D. In 1959, Plants Nos. 4, 5, and 6 were abandoned and the flow incorporated and discharged through Plant No. 13.

Variations in the quantities of sewage discharged in the Camp Pendleton subarea during the 1961-62 fiscal year are presented on Plate 7. Minor variations occur at the Camp Pendleton Treatment Plants, and major variations occur at the Fallbrook Naval Reservation Treatment Plant.

Future Quantities of Waste Water

On the basis of population estimates in Table 1 and 72 gallons per capita per day waste water contributions, estimated future sewage flows are given in Table 5.

TABLE 5

ESTIMATED FUTURE SEWAGE FLOWS PRODUCED
IN COASTAL SAN DIEGO COUNTY

In acre-feet

Year	Metropolitan subarea	County and Camp Pendleton subareas	Total for Coastal San Diego County
1970	96,260	17,055	113,315
1980	122,016	22,861	144,877
1990	148,216	32,820	181,036
2000	171,763	45,441	217,204

CHAPTER IV. MINERAL QUALITY OF WASTE WATERS

Quality of water supplies and quality of waste water flows are interdependent. The most significant factor affecting quality of waste waters is the quality of the water supplied to consumers. In turn, the quality of a reclaimable water supply and the possible beneficial uses depend on the quality of waste water flow.

Other factors also influence the quality of waste water. This chapter presents the results of the investigation into the various factors affecting quality of waste discharges in coastal San Diego County, it enumerates the standards used to evaluate water quality (these are given in greater detail in Appendix E), and it determines the suitability of reclaiming waste waters for possible beneficial uses.

Quality Criteria

In evaluating the mineral quality of sewage to test its suitability for reclamation, the first consideration should be the potential use, because each use has its own criteria. Other factors to be considered include the relative quality and availability of other sources of water and, if the reclaimed water is used for ground water recharge, salt balance.

Although direct use of reclaimed water would be limited to a few selected markets, recharge of ground water basins with reclaimed water would bring about its indirect use in all ways in which ground water is used. Therefore, waste waters of only the best mineral quality available should be used for recharge of ground water basins.

Mineral Criteria

General mineral quality criteria for sewage for reclamation in the San Diego coastal area are presented in Table 6. This table was based on quality criteria used for sewage for reclamation in the Los Angeles metropolitan area.(13)* The marginal limit of chlorides of 350 parts per million (ppm) in the Los Angeles area was increased to 500 ppm in this area because of the poorer quality of ground water available for the prevailing beneficial uses in coastal San Diego County.

TABLE 6

CLASSIFICATION OF MINERAL QUALITY OF SEWAGE FOR RECLAMATION PURPOSES

Constituent	Limiting values, in parts per million		
	Suitable	Marginal	Unsuitable
Chlorides	Less than 200	200 to 500	More than 500
Chlorides plus sulfates	Less than 500	500 to 1,000	More than 1,000
Boron	Less than 1	1 to 2	More than 2
Total dissolved solids	Less than 1,000	1,000 to 2,000	More than 2,000

Waters classed as suitable can usually be reclaimed successfully for prevailing and anticipated beneficial uses. Waters classed as marginal may be reclaimed for many beneficial uses but not for uses with the strictest quality requirements. Waters classed as unsuitable generally do not meet the requirements for normal beneficial uses. Should any one of the four constituents given in Table 6 fall in a less desirable class, the water is classified in the next lower class. Waste water classed as

*Numbers in parentheses indicate references listed in Appendix A.

suitable or marginal by these classification criteria could be considered unacceptable for reclamation because of abnormal concentrations of other pollutants, such as synthetic detergents, phenolic compounds, hexavalent chromium, or nitrates.

Legal Requirements

Consideration must always be given to regulations imposed on the reclamation of water from wastes by local authorities, the California State Department of Public Health, the State Water Quality Control Board, and the regional water quality control boards.

The California State Department of Public Health has the power to abate contamination by the Health and Safety Code, Sections 5410 to 5413, which prohibits discharge of sewage effluent in any manner that will result in contamination or nuisance. Power to issue regulations concerning pollution and nuisance resulting from sewage effluent discharge is vested in the regional water quality control boards by Water Code Section 13053.

Injection of reclaimed water into an aquifer is permitted by Section 4458 of the Health and Safety Code, upon a finding by the regional water quality control board that water quality is not adversely affected by such injection. Injection must also meet regulations of the State Board of Public Health.

Factors Affecting Mineral Quality of Waste Waters

Waste water flows in the study area generally consist of three components: domestic wastes, industrial wastes, and infiltration water. The major factors that affect the quality of a waste water are: the mineral quality of the water supply, the mineral pickup resulting from domestic and industrial use, and the quantity and quality of the infiltration water.

Mineral Quality of Water Supplies

The most significant factor affecting the mineral quality of a waste water is the quality of the original water supply. However, because of the addition of minerals through domestic and industrial use, the mineral content of a waste water is invariably higher than the mineral content of the original supply. Conventional waste treatments do not appreciably affect this mineral quality. Thus, upgrading or downgrading the mineral quality of the water supply will correspondingly upgrade or downgrade the mineral quality of the resulting waste water.

Water is supplied to coastal San Diego County from the Colorado River and local water supplies. Local water supplies consist of surface water from surface reservoirs, ground waters, and reclaimed waste water. Since the use of Colorado River water began in 1947, San Diego County has become increasingly dependent on this source. About 85 percent of the water used in the County is Colorado River water. Thus, the quality of the San Diego County water supply and the resulting waste water will be influenced primarily by the mineral quality of Colorado River water, with varying minor influences from the local supplies.

The overall quality of all water supplied to coastal San Diego County lies on the border line between class 1 and class 2 irrigation waters. Domestic waters may be classified as "very hard" in average quality. Total dissolved solids content varies from less than 100 ppm in well water supplies near the Sutherland Reservoir, approximately

35 miles northeast of the City of San Diego, to several thousand ppm in sea-water intruded ground waters near the coast.

Colorado River Supply. Colorado River water may be classed domestically as "very hard" and agriculturally between class 1 and class 2 irrigation water. Mineral analyses of Colorado River water delivered to the Los Angeles metropolitan area from 1945 through 1960 are shown in Table 7.

TABLE 7

MINERAL ANALYSES OF COLORADO RIVER WATER DELIVERED TO LOS ANGELES METROPOLITAN AREA FROM 1945 THROUGH 1960

(Average for years 1945 through 1960)

Period	Concentration of mineral constituents, in parts per million							
	Chloride		Boron		Sulfate		Total dissolved solids	
	Natural	Softened	Natural	Softened	Natural	Softened	Natural	Softened
1945-1946	92	99	0.10	0.10	345	345	757	744
1946-1947	91	98	0.10	0.10	333	333	737	724
1947-1948	90	99	0.10	0.10	325	328	728	732
1948-1949	85	95	0.10	0.10	314	316	701	740
1949-1950	79	84	0.10	0.10	295	296	666	693
1950-1951	79	83	0.10	0.10	290	290	661	692
1951-1952	80	83	0.10	0.10	286	286	652	668
1952-1953	77	81	0.16	0.16	277	277	631	659
1953-1954	75	79	0.13	0.13	276	276	632	651
1954-1955	81	85	0.16	0.16	292	292	669	694
1955-1956	98	104	0.17	0.17	342	342	766	799
1956-1957	109	114	0.16	0.16	364	364	815	836
1957-1958	100	106	0.13	0.13	323	323	738	771
1958-1959	72	77	0.09	0.09	269	269	617	634
1959-1960	74	78	0.11	0.11	263	263	609	629
AVERAGE	85	91	0.12	0.12	306	307	692	711

Note: Samples taken from the F. E. Weymouth Softening and Filtration Plant at La Verne.

Average values for these analyses are: total dissolved solids, 692 ppm; boron, 0.12 ppm; sulfates, 306 ppm; and chlorides, 85 ppm. Mineral analyses of Colorado River water samples taken from the San Diego County aqueducts in 1962 are presented in Table 8.

TABLE 8

MINERAL ANALYSES OF WATER SAMPLES TAKEN FROM COLORADO RIVER AQUEDUCTS, BARRETT LAKE, EL CAPITAN RESERVOIR, AND SUTHERLAND RESERVOIR IN SAN DIEGO COUNTY DURING 1962

Constituents*	Colorado River Aqueducts**	Barrett Lake	El Capitan Reservoir	Sutherland Reservoir
pH	8.1	8.4	8.0	8.8
Electrical conductance	1,149	980	634	518
Calcium	84	40	46	30
Magnesium	32	36	22	18
Sodium	105	109	50	46
Potassium	5	9	6	12
Carbonate	0	4	0	11
Bicarbonate	143	291	186	138
Sulfate	302	68	87	52
Chloride	95	118	54	50
Nitrate	2.4	0.6	1	0.3
Fluoride	0.4	0.4	0.2	0.2
Silica	13	7	23	6
Total dissolved solids	767	578	386	303
Total hardness as $CaCO_3$	340	244	207	146
Percent sodium	40	50	34	40

*All chemical constituents are in ppm except pH, electrical conductance, and percent sodium. Electrical conductance is in micromhos per cm. at 25° C.

**Analyses for samples collected at west portal of San Jacinto Tunnel.

The average values are: total dissolved solids, 767 ppm; sulfates, 302 ppm; and chlorides, 95 ppm. Because the concentration of boron was not reported, the concentration was assumed to be similar to that reported for the river water delivered to the Los Angeles area. These analyses indicate sulfate and total dissolved solids contents greater than the United States Public Health Service Drinking Water Standards recommended concentrations of 250 ppm and 500 ppm, respectively.

Ground Water Supplies. The San Diego County ground water supplies come from a number of wells and springs which deliver water from underground basins. From these, 17 wells were selected as yielding water representative in quality of the overall ground water supply in the study area. Of the 17 wells, 7 are in the metropolitan subarea and 10 are in the county subarea. Well locations are shown on Plate 2. The ground water supply may be classed as "very hard" for domestic use and from class 2 to class 3 irrigation water for agricultural use. In general, the ground waters in the study area are poorly suited for domestic consumption.

San Diego Metropolitan Subarea. Mineral analyses of samples obtained from the wells in the San Diego metropolitan subarea during 1962 are presented in Table 9. The total dissolved solids content varied from 850 to 1,932 ppm, electrical conductance ranged from 1,560 to 3,150 micromhos per centimeter, and chloride content varied from 287 to 667 ppm. Based on the above results, the well waters in this subarea can be designated as class 2 irrigation water except for well number 1, near El Cajon, and well number 5, on the lower Sweetwater River. Because of high chloride content in these two areas, the waters are designated as class 3 irrigation water.

San Diego County Subarea. Mineral analyses of samples from representative wells in the San Diego County subarea during 1962 are presented in Table 10. For these samples, the total dissolved solids content ranged from 354 to 1,650 ppm, electrical conductance from 680 to 2,350 micromhos per centimeter, and chloride content from 66 to 533 ppm. Most well waters in this subarea can be designated as class 2 irrigation water.

TABLE 9

MINERAL ANALYSES OF GROUND WATERS IN
SAN DIEGO METROPOLITAN SUBAREA DURING 1962

Constituent*	Well No. 1 16S/1W-2K6	Well No. 2 15S/1W-30K2	Well No. 3 16S/2W-17L1	Well No. 4 16S/3W-5E1	Well No. 5 17S/2W-36D1	Well No. 6 18S/1W-19D1	Well No. 7 19S/2W-5Q2
pH	7.2	7.0	7.7	7.6	7.3	7.2	7.4
Electrical conductance	1,990	1,560	1,825	1,900	3,150	1,560	1,900
Calcium	130	77	98	56	196	76	144
Magnesium	61	67	41	43	78	35	26
Sodium	220	173	214	290	375	175	207
Potassium	1	2	3	6	1	1	4
Carbonate	0	0	0	0	0	0	0
Bicarbonate	318	288	415	419	446	219	299
Sulfate	177	122	146	183	318	75	232
Chloride	388	314	287	307	667	339	310
Nitrate	60.0	34.0	0	0	7.0	0	7.4
Fluoride	0.4	0.4	0.4	0.6	0.4	0.4	0.8
Boron	0.2	0.2	0.3	0.5	0.5	0.2	0.1
Silica	47	32	14	15	21	33	35
Total dissolved solids	1,324	948	1,006	1,106	1,932	850	1,111
Total hardness as $CaCO_3$	574	456	417	316	808	337	465
Percent sodium	45	45	53	66	50	53	49

*All chemical constituents are in parts per million, except pH, electrical conductance, and percent sodium. Electrical conductance is in micromhos per cm. at 25° C.

TABLE 10

MINERAL ANALYSES OF GROUND WATERS IN
SAN DIEGO COUNTY SUBAREA DURING 1962

Constituent*	Well No. 8 18S/5E-9K1	Well No. 9 11S/4W-33G1	Well No. 10 12S/2W-9C3	Well No. 11 13S/4W-23H1	Well No. 12 14S/2W-13L1	Well No. 13 13S/1E-17J2	Well No. 14 14S/3W-7P6	Well No. 15 10S/3W-12C1	Well No. 16 12S/4W-26H1	Well No. 17 9S/3W-17C1
pH	7.7	8.0	7.7	7.3	7.4	7.5	7.9	7.5	7.7	7.4
Electrical conductance	680	1,500	1,080	2,350	2,260	870	1,660	1,102	1,460	1,290
Calcium	59	63	88	104	133	46	101	76	46	83
Magnesium	18	35	29	75	66	23	45	50	28	56
Sodium	63	182	105	290	239	81	210	90	210	93
Potassium	4	1	5	3	1	3	13	5	2	4
Carbonate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	299	169	143	197	311	140	322	247	223	229
Sulfate	11	67	309	287	240	27	184	219	90	167
Chloride	66	337	97	533	434	156	318	103	282	207
Nitrate	7	0.0	2	7	6	31	0.0	1	0.0	0.0
Fluoride	0.4	0.2	0.4	1	1	0.8	0.1	0.4	0.6	0.1
Boron	0.1	0.4	0.1	0.3	0.1	0.0	0.4	0.0	0.3	0.1
Silica	28	33	10	38	47	46	18	25	35	34
Total dissolved solids	354	818	784	1,650	1,436	537	1,130	775	816	896
Total hardnes as $CaCO_3$	220	302	337	568	603	210	435	393	231	439
Percent sodium	38	57	40	52	46	45	50	33	67	31

*All chemical constituents are in parts per million, except pH, electrical conductance, and percent sodium. Electrical conductance is in micromhos per cm. at 25° C.

Local Surface Supplies. Local surface water supplies may be classed domestically as "moderately hard" and agriculturally as class 1 irrigation water. During 1962, samples were obtained from several San Diego surface water supplies, including Barrett Lake, El Capitan Reservoir, and Sutherland Reservoir. These three reservoirs, owned by the City of San Diego, were chosen as representative surface water supplies. The locations of these reservoirs are shown on Plate 2. Other reservoirs, such as Lake Hodges, San Vicente Reservoir, and Sweetwater Reservoir, are supplemented with Colorado River water and thus are very similar in quality to the Colorado River supply.

The mineral analyses of the samples taken from the representative reservoirs were averaged, and the results are presented in Table 8. The total dissolved solids varied from 303 to 578 ppm, sulfates from 52 to 87 ppm, and the chloride content from 50 to 118 ppm. The results of the analyses indicate a water supply of satisfactory quality. The overall quality is somewhat better than that of the Colorado River supply.

Future Supplies. On completion of the California Aqueduct in 1972, the water supply for coastal San Diego County will include water from local sources, from the Colorado River, from waste water reclamation, from sea-water conversion, and from Northern California. The probable mineral quality of Feather River water to be delivered to Southern California is presented in Table 11. This water should have a total dissolved solids content of 200 ppm, electrical conductivity of 311 micromhos per centimeter, and chloride content of 30 ppm. By the time the water is delivered in Southern California, it may be classed for domestic use as "soft" to "moderately hard" and for agricultural use as class 1 irrigation water. The overall quality of the future coastal San Diego County water supply will be considerably upgraded by the addition of Northern California water to existing sources.

TABLE 11

PROBABLE MINERAL QUALITY OF STATE WATER PROJECT WATER DELIVERED TO SOUTHERN CALIFORNIA*

Mineral constituent	Concentration of mineral constituent, in parts per million, (except as noted)
Hydrogen ion concentration	7.1 - 8.2**
Electrical conductance	311**
Calcium + Magnesium	30 - 35
Sodium + Potassium	28
Carbonate	0
Bicarbonate	100
Sulfate	34
Chloride	30
Nitrate	2
Fluoride	1.5
Boron	0.5
Silica	20
Total dissolved solids	200
Total hardness as calcium carbonate	100
Percent sodium	40**

*Adapted from Department of Water Resources Bulletin No. 78, Appendix B, Table 19, page 75.
**In standard units for measurement of this property of water.

Other possibilities of upgrading the quality of the water in the study area include the development and operation of sea-water conversion projects, which produce water of extremely high quality. As water supply quality and, therefore, waste water quality reaches a higher level, water reclamation possibilities will improve proportionately.

Domestic and Industrial Use

Domestic and industrial water use can result in extensive deterioration of the mineral quality of water. As previously discussed, the mineral content of the waste water depends on both the mineral content of the water supply and the particular use of the water.

The increase in mineralization resulting from domestic use was studied by the University of California at Los Angeles in preparing a report on waste water reclamation and utilization for the California State Water Quality Control Board. The results are presented in Table 12.

TABLE 12

NORMAL RANGE OF MINERAL PICKUP IN WATER USED FOR DOMESTIC PURPOSES*

Mineral constituent	Normal range, in parts per million (except as noted)
Total dissolved solids	100 - 300
Boron	0.1 - 0.4
Percent sodium	5 - 15**
Sodium	40 - 70
Potassium	7 - 15
Magnesium	15 - 40
Calcium	15 - 40
Total nitrogen	20 - 40
Phosphate	20 - 40
Sulfate	15 - 30
Chloride	20 - 50
Total alkalinity	100 - 150

*Adapted from State Water Pollution Control Board Publication No. 9, Chart I-8, page 25(16).
**In percent.

Chlorides are also introduced into waste water through the use of ion exchange water softeners. The results of a study on the "Effects of Water Softener Regeneration Wastes"(5) made in 1952 are presented in

Table 13. The results of this study indicate a possible chloride increase ranging from 221 to 428 ppm, depending on the type of ion exchanger used.

TABLE 13

ESTIMATED INCREASE OF SODIUM CHLORIDE IN DOMESTIC SEWAGE FROM WATER SOFTENERS(5)

Assumption	Type of ion exchanger used			
	1 Synthetic zeolite gel	2 Synthetic zeolite gel	3 High capacity resin	4 High capacity resin
1. All wastes go to private sewage system				
2. Complete dilution in annual sewage flow				
3. Water supply hardness that of Metropolitan Water District's raw water (grains/gal.)	17.12	17.12	17.12	17.12
4. Domestic sewage (gal./cap./day)	50*	50*	50*	50*
5. Average capacity of the exchange medium (grains/cu. ft.)	14,000	14,000	27,000	27,000
6. Average quantity of salt for regeneration (lbs./cu. ft./exchanger/regeneration)	8	8	12	12
7. Water softened (gal./cap./day)	30	20	30	20
Salt increase as NaCl in sewage (ppm)	705	469	550	364
Salt increase as Cl, (ppm)	428	285	334	221
Salt increase as Na, (ppm)	277	184	216	143

*Assumed for worst conditions - sewage flow generally varies from 50 to 70 gal./cap./day in San Diego County.

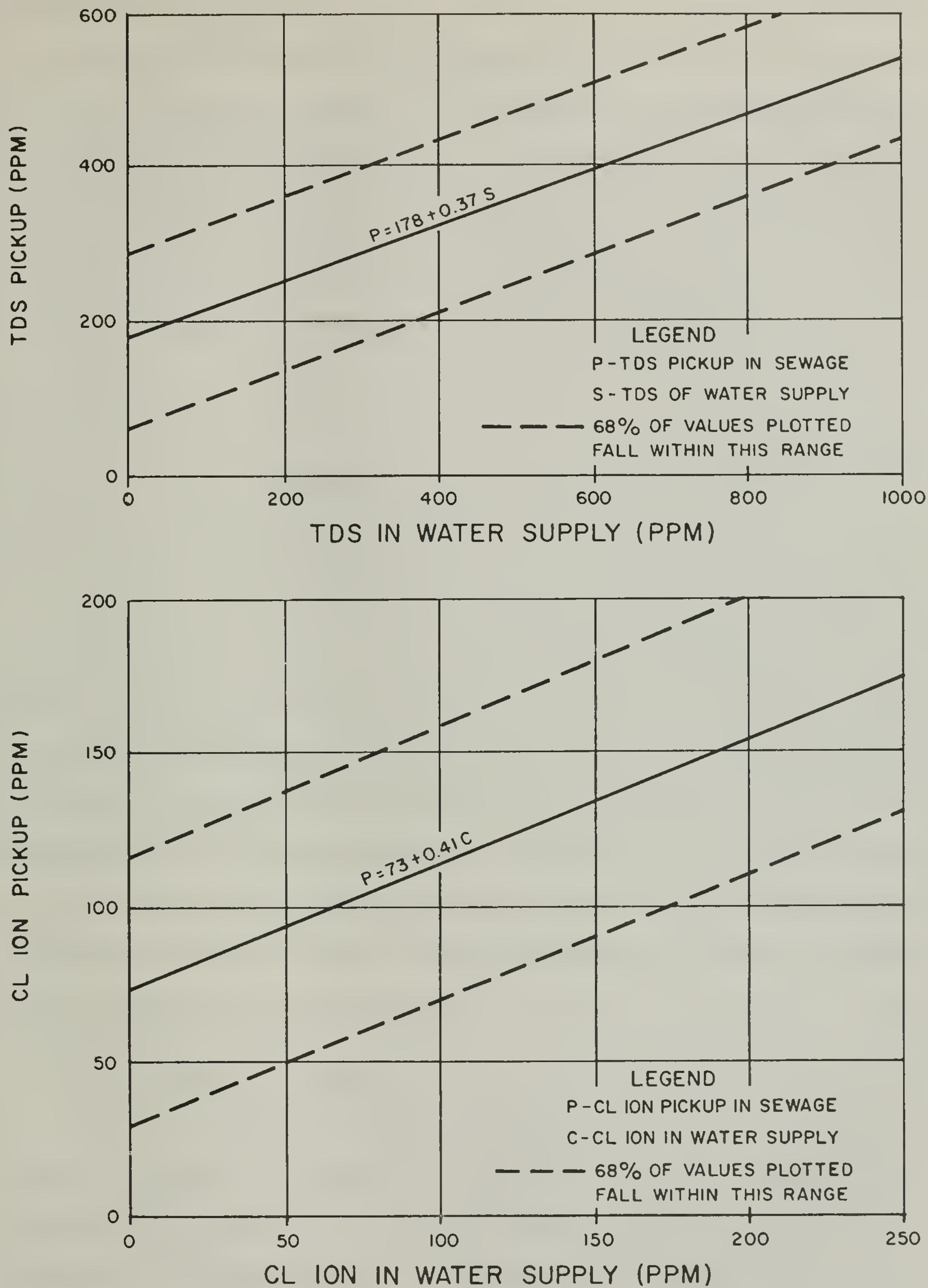
Although the number of large water using industries in the study area is not very great, the wastes produced by these industries can exert a major influence on the mineral quality of resulting sewage flows. Certain types of industries, such as chemical, mining, and aircraft, produce wastes that are highly mineralized and cause gross deterioration of waste water quality.

Mineral Pickup Estimation

A method for estimating dissolved solids and chloride ion pickup in waste waters based on water quality of the supply is presented on Figure 6. The plots are based on data collected in 1958 concerning the mineral quality of water supplied and resulting waste waters for 20 cities in Southern California and for eight trunk sewers within the San Diego Metropolitan Sewerage System[4]. The actual ranges of the estimated solids and chloride ion pickup were calculated by the least squares method of determining the line of best fit. The dotted lines represent the expected range of pickup at a 68 percent confidence level. The probable dissolved solids and chloride ion pickup can be estimated from the amount present in the original water supply. These empirical curves should not be used for any areas other than Southern California, as any proportions of domestic, industrial, or agricultural wastes other than those found in this study could change the curves considerably.

Infiltration Water

Infiltration water is the water that enters sewers from the subsurface through poor joints, cracked pipes, and manhole walls, and from the surface through perforated manhole covers. The amount of infiltration



TOTAL DISSOLVED SOLIDS AND CHLORIDE ION PICKUP IN SEWAGE IN SOUTHERN CALIFORNIA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1965

depends on the quality of construction of the sewer system, the height of the ground water table, and the character of the soil. The quality of the infiltrating water will depend on its origin -- surface or subsurface. In general, surface infiltration waters are of good quality, but subsurface infiltration waters may vary greatly in quality. Subsurface infiltration has a pronounced effect in coastal areas where the infiltrating waters may be highly saline, thus producing gross deterioration of the waste water.

Other Factors

Use of such products as plastics, fibers, medicinal chemicals, dyes, and synthetic detergents has increased considerably during the past two decades. Some of these organic products find their way into waste waters through domestic and industrial use. In most instances, these organic products can be removed by conventional sewage treatment processes. A notable exception is synthetic detergents. Because of the widespread use of synthetic detergents and because of their resistance to ordinary treatment, they are now considered a serious problem to water reclamation. A study is now under way by the State Water Quality Control Board to alleviate this problem by establishing control over the composition of detergents. Another study by the Department of Water Resources, under contract with the State Water Quality Control Board, to evaluate the persistence and dispersion of synthetic detergents in the ground water along the Santa Ana River in the Riverside-Colton area, has been completed; and the final report was published September 1964. Synthetic detergents that can be broken down in normal sewage treatment are now appearing on the market and should replace the nondegradable detergents in the near future.

Quality of Waste Water and Suitability for Reclamation

Discharges from waste water treatment plants in the study area may be classified as being "very hard" for domestic use and ranging from class 2 to class 3 for irrigation. Several exceptions to this general classification are: the effluent from the Camp Pendleton subarea, which varies in hardness from "moderately hard" to "very hard"; the effluent from the Alpine treatment plant, which is "moderately hard"; and the effluent from the Julian plant, which is "moderately hard" and is class 1 for irrigation. Waste water quantity and quality in the study area are depicted on Plates 8, 9A, and 9B.

The suitability of a waste water to be reclaimed and used beneficially depends on many factors, the most significant of which is mineral quality. Especially important in determining suitability for reclamation is content of chloride, boron, sulfate, and total dissolved solids. Based on these criteria, a waste water is classified as suitable, marginal, or unsuitable according to limits shown in Table 6.

The quality of plant discharges and their classification according to suitability for reclamation are discussed in the following section under appropriate subareas.

San Diego Metropolitan Subarea

Mineral analyses of samples from plant effluents in the metropolitan subarea are presented in Table D-5 of Appendix D. Those most significant in determining suitability for reclamation are summarized in Table 14. One discharge is rated suitable -- the one at the Coronado "B" Street outfall. Nine discharges are classed as marginal for

Laboratory in Point Loma Plant where waste water is analyzed.

TABLE 14

SUMMARY OF MINERAL QUALITY OF WASTE WATER FROM SEWAGE PLANTS IN SAN DIEGO METROPOLITAN SUBAREA

Plant	Mineral quality concentrations, in parts per million				Suitability of mineral quality	Irrigation classification
	TDS	Cl	Cl + SO_4	B		
Chula Vista ("G" Street plant)	1,200	197	506	1.0	Marginal	2
("J" Street plant)	1,610	283	391	1.1	Marginal	2
Coronado ("B" Street outfall)	785	94	417	0.0	Suitable	2
("K" Street outfall)	1,365	395	721	0.2	Marginal	3
El Cajon	1,690	381	689	1.0	Marginal	3
Gillespie Field	1,004	238	412	3.5	Unsuitable	3
Imperial Beach	11,028	5,754	6,685	1.6	Unsuitable	3
Lakeside	1,436	327	779	0.9	Marginal	2
Palm City	4,232	2,184	2,580	1.2	Unsuitable	3
Ream Field	1,252	325	525	0.6	Marginal	2
San Diego (Harbor Drive)	1,950	534	823	1.3	Unsuitable*	3
Santee	1,125	220	518	0.9	Marginal	2
San Ysidro	1,266	280	685	0.7	Marginal	2
Spring Valley	1,850	459	879	1.3	Marginal	3

*A portion of the flow from the Harbor Drive plant was considered marginal based on analyses of samples from trunk sewers.

reclamation purposes and four are classed as unsuitable. These are from Gillespie Field, Imperial Beach, Palm City, and San Diego Harbor Drive Treatment Plants.

Mineral analyses of samples from some of the trunk sewers that make up the San Diego Metropolitan Sewerage System are presented in Table D-6, Appendix D.

The San Diego Metropolitan Sewerage System includes a number of trunk sewers which carry waste waters that are marginal for reclamation purposes. These trunk sewers are listed in Table 15, together with mineral concentrations and appropriate classifications.

TABLE 15

SUMMARY OF MINERAL QUALITY OF WASTE WATER FROM TRUNK SEWERS IN SAN DIEGO METROPOLITAN SUBAREA

Plant	Mineral quality concentrations, in parts per million				Suitability of mineral quality	Irrigation classification
	TDS	Cl	$Cl + SO_4$	B		
Balboa	1,026	144	506	0.8	Marginal	2
Cabrillo	1,064	145	493	0.8	Marginal	2
East San Diego	1,300	202	575	0.8	Marginal	2
Encanto	1,696	420	795	0.8	Marginal	3
La Jolla	1,892	459	843	0.6	Marginal	3
Linda Vista	1,060	160	497	1.2	Marginal	2
Mission Valley	1,180	232	568	0.9	Marginal	2
Murray Canyon	1,172	150	420	0.6	Marginal	2
National City	1,056	194	330	0.6	Marginal	2
Rose Canyon	1,124	229	608	1.0	Marginal	2

On the basis of the data shown in Tables 14 and 15 and the information on quantity of waste waters presented in Appendix D, the approximate quantities of waste water in each classification are: 0.4 mgd, suitable; 40.8 mgd, marginal, and 18.6 mgd, unsuitable. Of the marginal waste water, approximately 31.2 mgd is flow handled by the San Diego trunk sewers. Thus, even with the generally poor quality of water supply now available, about 41.2 mgd of sewage in the San Diego metropolitan subarea can be reclaimed. The deliveries of high quality Northern California water expected in 1972 should considerably increase the percentage of waste water which can be reclaimed as well as move a greater proportion of it into the "suitable" category. Under the present operation of the San Diego Metropolitan Sewerage System, about 40 mgd of reclaimable sewage in the metropolitan subarea is discharged to the ocean. This amounts to 74 percent of the total flow discharged to the ocean.

San Diego County Subarea

Mineral analyses of samples from plant effluents in the county subarea are presented in Table D-7, Appendix D. Table 16 shows the classification according to suitability for reclamation. These data show that approximately 0.06 mgd are suitable, about 8.2 mgd are marginal, and approximately 0.7 mgd are unsuitable for reclamation. Of an available 9.0 mgd, about 8.3 mgd of sewage in the county subarea can presently be used for waste water reclamation; and, as with the San Diego metropolitan subarea, the proportion can be expected to increase with the delivery of Northern California water.

TABLE 16

SUMMARY OF MINERAL QUALITY OF WASTE WATER FROM SEWAGE PLANTS IN SAN DIEGO COUNTY SUBAREA

Plant	Mineral quality concentrations, in parts per million				Suitability of mineral quality	Irrigation classification
	TDS	Cl	$Cl + SO_4$	B		
Alpine	814	171	303	0.8	Suitable	2
Callan	1,008	196	558	0.3	Marginal	2
Cardiff	1,365	272	614	0.9	Marginal	2
Carlsbad	2,080	789	1,068	0.5	Unsuitable	3
Del Mar	1,390	340	720	0.9	Marginal	2
Encinitas	1,550	288	635	1.3	Marginal	2
Escondido (old plant)	1,450	326	646	0.7	Marginal	2
(new plant)	1,292	284	607	0.9	Marginal	2
Fallbrook	1,020	182	526	0.7	Marginal	2
Julian	328	50	98	0.3	Suitable	1
Oceanside	1,728	470	792	0.8	Marginal	3
Pomerado	1,254	308	649	0.8	Marginal	2
Ramona	1,198	298	516	0.8	Marginal	2
Rancho del Campo	758	127	208	0.5	Suitable	2
Rancho Santa Fe	1,468	332	662	0.4	Marginal	2
San Marcos	1,265	256	564	0.1	Marginal	2
Solana Beach	2,070	725	1,074	0.6	Unsuitable	3
Sorrento	7,970	2,613	4,936	1.1	Unsuitable	3
Viejas Honor Camp	746	138	193	0.2	Suitable	2
Vista	1,320	286	499	0.1	Marginal	2

Camp Pendleton Subarea

Mineral analyses of samples from plant effluents in the Camp Pendleton subarea are presented in Table D-8, Appendix D. Table 17 summarizes the classification according to suitability for reclamation. All of these waste waters, 3 mgd, are usable for reclamation.

TABLE 17
SUMMARY OF MINERAL QUALITY OF WASTE WATER FROM SEWAGE PLANTS IN CAMP PENDLETON SUBAREA

Plant	Mineral quality concentrations, in parts per million				Suitability of mineral quality	Irrigation classification
	TDS	Cl	$Cl + SO_4$	B		
Camp Pendleton						
Plant No. 1	950	211	345	0.6	Marginal	2
Plant No. 2	746	196	307	0.3	Suitable	2
Plant No. 3	982	308	432	0.6	Marginal	2
Plant No. 8	940	218	338	0.5	Marginal	3
Plant No. 9	1,305	322	388	0.5	Marginal	2
Plant No. 10	880	180	278	0.6	Suitable	2
Plant No. 11	1,015	246	336	0.4	Marginal	2
Plant No. 12	615	160	252	0.3	Suitable	2
Plant No. 13	1,092	275	421	0.6	Marginal	2
Fallbrook Naval Reservation	1,070	--	--	--	--	-

CHAPTER V. WASTE WATER RECLAMATION PROJECTS

Reclaimed water from sewage and industrial wastes has long been used for agricultural irrigation in the arid and semiarid regions of the Southwest. Reclaimed water is also used to create artificial lakes and streams for recreation, to produce edible fish and waterfowl, to replenish ground water storage and to operate sanitary systems and cooling systems.

Waste water reclamation may be planned, incidental, or involuntary. Planned reclamation is recovery of water primarily for beneficial uses. Incidental reclamation is the reuse of waste effluent discharged from plants that are operated primarily for sanitary disposal. Involuntary reclamation takes place when the waste water mingles with water from other supply sources, such as in lakes, streams, or ground water.

For the purposes of this study, planned reclamation is divided into two classes. In class A planned reclamation, the facility is built specifically for waste water reclamation, is located apart from the sewage treatment or disposal plant, and operates separately from it. In class B planned reclamation, the facility is operated in conjunction with the sewage treatment or disposal plant.

Few planned reclamation systems are in operation in the country, although numerous examples of incidental and involuntary reclamation may be found. A good example of class A planned reclamation is the Los Angeles County Sanitation District's Whittier Narrows Reclamation Plant near Whittier, where water is reclaimed for ground water recharge. Here, 10 mgd of sewage from a trunk sewerline is treated and spread for ground water replenishment. Operation of the plant has been very successful, and plans are being made to expand the plant to 50 mgd.

In coastal San Diego County, all three types of waste water reclamation are practiced. However, no class A system is in operation. Class B planned reclamation is practiced at Santee, Encinitas, Oceanside, Camp Pendleton and other areas. Incidental reclamation is used at Fallbrook, Julian, Callan, Lakeside, and Poway (Pomerado). Involuntary reclamation occurs at Alpine, Escondido, Ramona, San Marcos, San Ysidro, and Vista.

Feasibility of Waste Water Reclamation

Before the reclamation of waste water is considered, an adequate source of usable water must be available, a sufficient demand for reclaimed water must exist, the project must be economically feasible, and the agency financing the project must be sure it has legal protection for its investment.

The questions of available quantity and quality of waste waters were discussed in the two preceding chapters. This chapter will explore the other questions and will also describe the present, proposed and potential waste water reclamation projects in the study area.

Costs of Waste Water Reclamation

The costs of reclaiming water from a class B plant should be much less than from a class A plant because the class B plant is being used for both sanitary disposal and reclamation. Since the costs of sanitary disposal must be incurred by a community whether or not it engages in water reclamation, the principal cost of reclamation will be those costs for treatment beyond the conventional sanitary disposal requirements.

The costs used here for reclaiming water are those from class A plants, as are proposed for the metropolitan subarea. As was pointed out earlier, each agency using the Metropolitan Sewerage System pays an operating cost based on the amount of sewage it discharges to the system (generally about $14 per acre-foot). In computing their costs for reclaiming water, these agencies can deduct this charge from their cost for each acre-foot reclaimed. It is recognized that operation and maintenance of the system will be affected by reduction of influent flows.

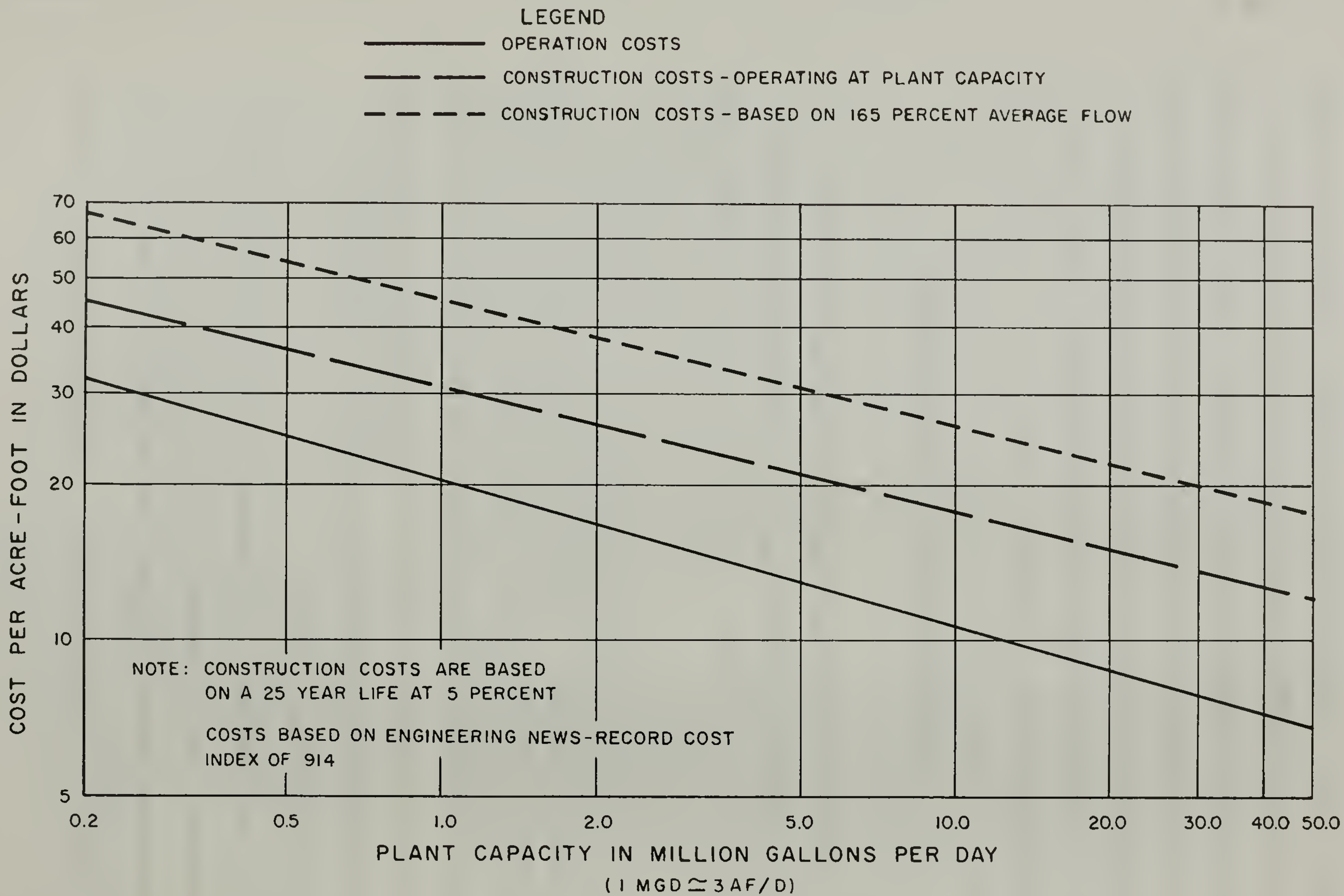
Costs of reclamation vary, depending on the quantity of waste water needed, type of treatment, operation, storage, transmission, and water use.

Presently, the activated sludge-type treatment is favored for waste water reclamation. Figure 7, based on past studies (2,18,19,20)*, gives costs per acre-foot for constructing and operating activated sludge-type plants. Construction costs were based on capital recovery of the costs at 5 percent interest and an expected average life of 25 years for structures and mechanical equipment. Preliminary treatment and most of the sludge handling are not required for class A plants and are not included in these cost estimates. The sludge may be disposed of in the waste water line from which the water is reclaimed. Sufficient residual flow should be maintained to carry the sludge to the treatment plant concerned. Additional cost of sludge disposal should be considered.

Water use determines the treatment, storage, and size of treatment plant required. For an irrigation system in coastal San Diego County, the treatment plant would need to be designed for flows of

---

*Numbers in parentheses indicate references listed in Appendix A.



CONSTRUCTION AND OPERATION COSTS FOR ACTIVATED SLUDGE-TYPE WASTE WATER RECLAMATION PLANTS

FIGURE 7

165 percent of average daily flow. The design capacity of plants using the effluent for irrigation was based on 165 percent of average daily flow, using the July demand in Table 18 as the maximum expected. Storage of the waste water before transmission is necessary for fluctuations of demand and unexpected shutdowns. For irrigating parks and golf courses, the water is applied when the park or golf course is not in use. A one-day supply for maximum demand should be sufficient for storage.

Quantities of water needed for golf courses, parks, and freeway landscaping in coastal San Diego County are 2 to 3 acre-feet per acre per year. Monthly requirements, as obtained from Bulletin No. 61(9), vary as shown in Table 18.

TABLE 18

MONTHLY DEMAND FOR RECLAIMED WASTE WATER FOR IRRIGATED AGRICULTURE IN SAN DIEGO METROPOLITAN SUBAREA*

Month	Monthly demand in percent of total annual demand
January	2.7
February	2.2
March	3.8
April	6.5
May	10.9
June	12.8
July	13.7
August	13.6
September	12.5
October	9.5
November	7.2
December	4.6
TOTAL	100.0

*Adapted from Department of Water Resources Bulletin No. 61, "Investigation of Alternative Aqueduct Routes to San Diego County", page 65.(9)

The cost of storing and transmitting waste water includes cost of storage facilities, transmission pumps and structure, transmission pipe, and other land or equipment needed to transport the water to the irrigation site. Costs of storage and transmission depend on volume of storage, size of mains, distance, and difference in elevation between storage and point of distribution. This may cost from $3 to $14 per acre-foot; pumping costs may vary from 0 to $8 per acre-foot.

On the basis of the foregoing estimates and the treatment costs discussed later, the total cost of reclaimed water prior to distribution would vary from about $14 to $87 per acre-foot.

The nutrient value of waste water is very important when these waters are used for irrigation. Although nutrients contribute to the fertilizer value of waste water, they may or may not lower the overall cost to the individual irrigator because of difficulties encountered in the control of algae produced by excess nutrients. The nutrient value of waste water was not considered in calculating the costs of reclaimed water.

Legal Requirements

With the qualifications pointed out in Chapter IV, the necessary relationships for the use of reclaimed water fall into established contractual and water rights patterns. The user of reclaimable water would want to assure himself of rights to a firm enough supply to warrant investment in treatment facilities. Agreements concerning the quality of the reclaimed water and liability for failures in the system should be executed between the producer or entity in possession of the waste water and the party reclaiming the water.

Public agencies should be certain that they have the authority to enter into the necessary agreements to use reclaimable water. Authority to sell or dispose of effluent for reclamation is expressly granted by Health and Safety Code, Section 5008, to cities, counties, corporations, and districts operating sewage treatment systems.

Existing Waste Water Reclamation Projects

Waste water is reused in all three subareas of coastal San Diego County. About 15,700 acre-feet of waste water was reused during 1962-63 through planned, incidental, or involuntary reclamation in the study area. They are located on Plates 3A and 3B. Diagrams of the class B waste water reclamation systems are shown on Plate 10. The existing reclamation systems, other than the Point Loma plant in coastal San Diego County, are discussed in the following paragraphs.

San Diego Metropolitan Subarea

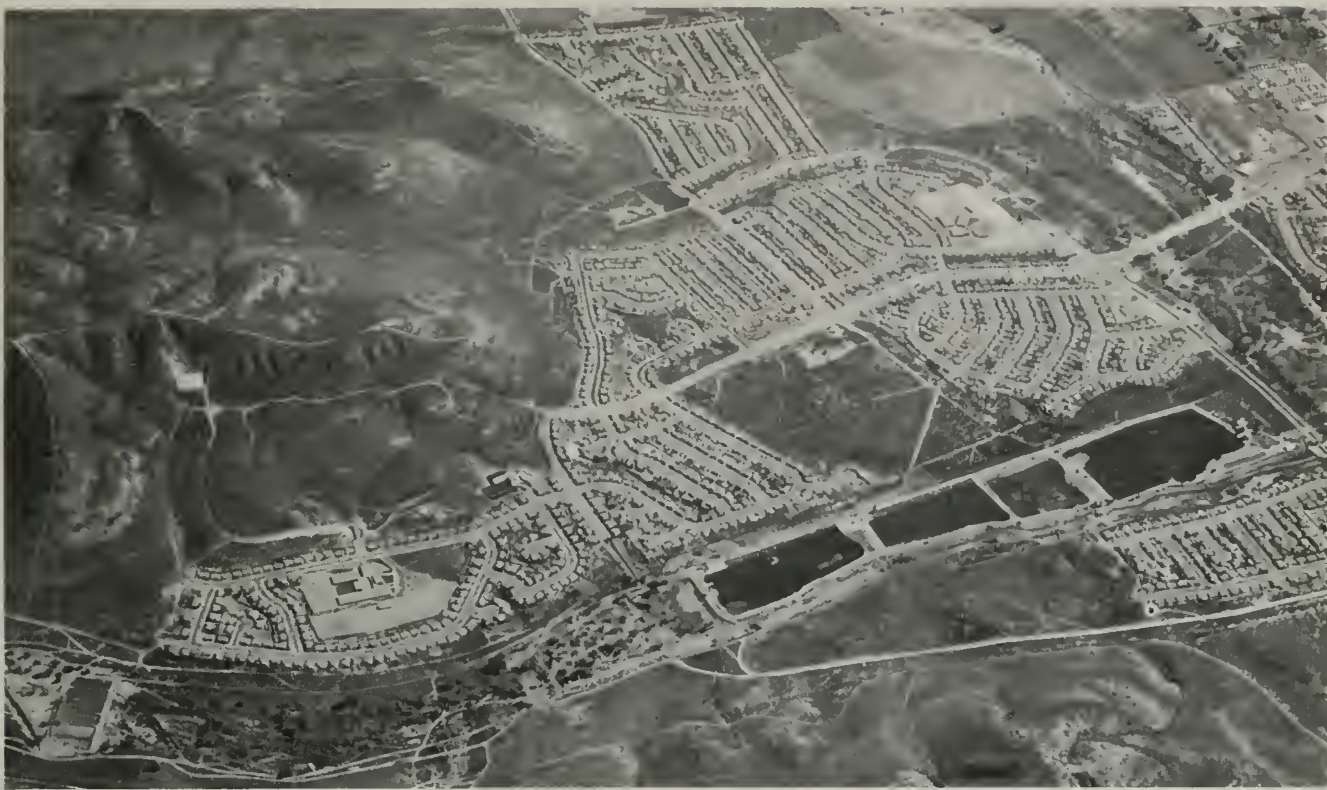
Since the completion of the new San Diego Metropolitan Sewerage System, only three waste discharges not connected to the Point Loma Treatment Plant remain in the metropolitan subarea. These are at Lakeside, Santee, and San Ysidro. Incidental reclamation is practiced at Lakeside, planned reclamation at Santee, and involuntary reclamation at San Ysidro.

Lakeside. The Lakeside Sanitation District discharges its effluent to percolation beds in the San Diego River. Treated effluent from the secondary plant is spread over 45,600 square feet of sand and percolates into the underlying ground water basin. All the effluent, about 196 acre-feet per year, is presently being reclaimed. No major problem has been encountered in the reclamation system.

Santee. Since 1961, the Santee County Water District has owned and operated a planned waste water reclamation system of small lakes for recreation. Plate 10 shows a schematic diagram of this system. The Santee sewage undergoes secondary treatment to meet sanitary quality requirements. The effluent from secondary treatment flows by gravity to a 16.3-acre oxidation pond (Lake 1) of about 74-acre-foot capacity for further treatment before being pumped about a mile upstream to Sycamore Canyon. The effluent then percolates into the shallow aquifer in Sycamore Canyon, where it mingles with the existing ground water. After traveling about half a mile through the soil, the effluent is collected by means of collection galleries for use in the recreational lakes. It is then chlorinated before entering Lake 4.

Santee Lake 4 has a surface area of 11 acres and contains about 53 acre-feet of water. Water from Lake 4 flows to Lake 3, which has a surface area of 7.5 acres and contains about 46 acre-feet of water. From here, the water goes to Lake 2, which has a surface area of 6.8 acres and a capacity of about 36 acre-feet of water. The effluent from Lake 2 is discharged into Sycamore Canyon Creek, a tributary of the San Diego River. Effluent from Lake 1 that is not pumped to the spreading area is discharged to Lake 2 and thence to the creek. Water leaving Lake 2 is pumped from wells downstream from the recreational area and used to irrigate a golf course.

Facilities at the Santee County Water District recreational area include picnic tables, barbecue pits, rest rooms, children's playground equipment, horseshoe courts, boatloading ramp, a boat dock, a boathouse, rental sailboats, and rental rowboats. Lakes



Courtesy Santee County Water District

Santee Lakes 1 through 4 at right
and percolation beds at left

3 and 4 are used for boating and fishing. Serious consideration is being given to opening these two lakes for swimming. The recreational facility is now being expanded.

San Ysidro. The City of San Diego operates a sewage lagoon for San Ysidro sewage effluent in the bed of the Tia Juana River, downstream from San Ysidro. Here, waste water percolates into the Tia Juana Ground Water Basin and mixes with other subsurface waters. Involuntary reclamation takes place when water is drawn from the basin for various uses.

San Diego County Subarea

In the county subarea, 24 waste discharges form 22 separate systems. Five are class B planned reclamation systems; a sixth is under construction. Incidental reclamation occurs at eight locations in the county subarea.

Because no ocean outfall exists at present, involuntary waste water reclamation either occurs or can occur at all the discharge sites. At 10 sites, involuntary reclamation is the only form that occurs.

Planned and Incidental Reclamation. The five class B planned reclamation systems now in operation in the county subarea are at Oceanside, Leucadia, Encinitas, Rancho Bernardo, and Valle Verde. At Fallbrook, a small class B planned reclamation plant is under construction.

Incidental reclamation occurs at Fallbrook, Oceanside, Romona, Escondido, Rancho Santa Fe, Poway Valley, Callan, and Julian.

Callan. The effluent from the San Diego Callan sewage treatment plant is reclaimed and used by the General Atomic's laboratory for irrigating its landscaped areas. The reclamation system has been in operation since the reactivation in February 1958 of a plant built in 1942 to serve Camp Callan.

Encinitas. All the waste effluent from the Encinitas Sanitary District sewage treatment plant is reclaimed for irrigation. The disposal plant was enlarged in 1957 to provide for both sewage disposal and waste water reclamation. This class B planned reclamation system provides irrigation water to a flower farm about 1 mile east of the plant. When available, up to 1 mgd can be used at the farm. A schematic diagram of the system is shown on Plate 10.

Escondido. Waste waters from the two Escondido sewage treatment plants are discharged to Escondido Creek. Some of the effluent is taken from the creek for gravel washing. The remainder of the sewage effluent infiltrates to the ground water.

Fallbrook. Part of the waste effluent from the Fallbrook Sanitary District sewage plant is reclaimed incidentally to irrigate lemon groves. The remainder of the effluent percolates into the bed of Fallbrook Creek, which results in involuntary reclamation.

Julian. Effluent from the Julian Sanitation District sewage plant is used to irrigate an apple orchard. The District discharges the waste effluent to Coleman Creek, where it is impounded in three ponds. Water is taken from the farthest downstream pond for irrigation.

Leucadia. Leucadia County Water District has been operating a new waste disposal and class B reclamation plant since early in 1963. The effluent is now being pumped to shallow ponds in San Marcos Creek near San Marcos Canyon for percolation to the ground water. In the future, the effluent will be used for irrigating a 150-acre golf course to be built east of the plant and pasture immediately west of the plant. A schematic diagram of the system is shown on Plate 10.

Oceanside. All the waste effluent from Oceanside is pumped to Whelan Lake for class B reclamation. Waste water in Whelan Lake recharges the Mission Valley Ground Water Basin, thereby supplementing the City's water supply and protecting the ground water basin against sea-water intrusion. This reclamation system has been in operation since July 1958; it was preferred to an ocean outfall discharge because of economics. A schematic diagram is shown on Plate 10.

The reclamation facilities consist of two primary and one secondary treatment plants, a pump station, and a pipeline to Whelan Lake. The lake serves as a spreading ground to recharge the underlying ground water basin. A new primary plant is under construction to supplement the other two plants.

Poway Valley (Pomerado). Waste effluent from the Pomerado County Water District's sewage treatment plant serving Poway Valley is discharged to Los Penasquitos Creek. Part of the effluent is used to irrigate pasture and grain crops, the remainder of the waste water percolates to ground water.

Ramona. At Ramona, waste water is reclaimed incidentally for irrigation from the Ramona Sanitation District sewage plant. Sewage effluent that is not used for irrigation percolates in the Santa Maria Creek bed.

Rancho Bernardo. A class B reclamation system is operated by the City of San Diego at Rancho Bernardo south of Lake Hodges. This system serves as a waste disposal plant as well as a waste water reclamation system. The effluent is used to irrigate a golf course. A schematic diagram is shown on Plate 10.

Rancho Santa Fe. The Rancho Santa Fe Sanitation District spreads all its sewage effluent for ground water recharge, using more than 4,000 square feet of percolation area, in the bed of the San Dieguito River.

Valle Verde. Waste effluent from the Valle Verde Community Services District sewage treatment plant will be used to irrigate a golf course. The class B reclamation plant was recently constructed to serve a housing development. A schematic diagram is shown on Plate 10.

Involuntary Reclamation. Ten of the agencies in the county subarea have involuntary reclamation only. These are:

Alpine. Waste water is discharged to Alpine Creek and percolates to ground water.

Cardiff. Waste effluent is discharged to San Elijo Lagoon, and the effluent percolates into the ground.

Carlsbad. All the waste water is discharged to Buena Vista Lagoon, which is used as a bird sanctuary.

Del Mar. Waste effluent percolates into the bed of the San Dieguito River.

Rancho Del Campo. Waste water is discharged to Campo Creek and percolates into the ground.

San Marcos. Waste water is discharged to San Marcos Creek and percolates into the ground.

Solana Beach. Waste effluent is discharged to San Elijo Lagoon, where it is used for a duck pond.

Sorrento. Waste water percolates into Los Penasquitos Creek for ground water basin recharge.

Viejas Honor Camp. Sewage effluent is discharged to a tributary of Sweetwater River and percolates into the ground.

Vista. Waste water is discharged to Buena Vista Creek and thence to Buena Vista Lagoon, which is used as a bird sanctuary.

Camp Pendleton Subarea

Waste water has been reclaimed for many years at Camp Pendleton Marine Corps Base. Effluent from nine sewage treatment plants in Camp Pendleton is reused for recreation, irrigation, ground water recharge, and protection against sea-water intrusion. Sewage effluent from the Fallbrook Naval Reservation is involuntarily reclaimed in Camp Pendleton.

Reclamation at Camp Pendleton is undertaken at class B systems. The camp was forced into waste water reclamation by a shortage of ground water underlying the area, its only source of supply.

Effluent from Sewage Treatment Plant No. 2 is used to irrigate a golf course. Lake O'Neill, a recreational lake, receives the flow from Sewage Treatment Plant No. 1. The remainder of the sewage effluent discharged on the base percolates into the ground. Operation of the reclamation systems has been very successful.

Proposed Waste Water Reclamation Projects

Several waste water reclamation projects have been proposed for coastal San Diego County. These projects include park irrigation, golf course irrigation, and ground water recharge. The major proposed reclamation projects (Plate 11) are in the San Diego metropolitan subarea.

San Diego Metropolitan Subarea

A plan for reusing waste water to irrigate Balboa and Mission Bay Parks[2] is presently being considered by the San Diego City Council. Balboa Park contains approximately 1,400 acres near the center of the City of San Diego. Mission Bay Park, in the northern part of the City, contains approximately 4,600 acres, of which almost half is water. The plan also includes future uses of reclaimed water, such as irrigation of greenbelt areas and ground water recharge.

Irrigation and ground water recharge are potential beneficial uses for reclaimed water. The estimated average daily reclaimed water requirement in an ultimate peak month is 4 mgd for Balboa Park and 6 mgd for Mission Bay Park. An irrigation water requirement of about 22 mgd during peak summer months is predicted for greenbelt areas in metropolitan San Diego. Greenbelt areas, amounting to 9,663 acres, include recreational and athletic fields, cemeteries, parks, and golf courses, but do not include scenic freeways. Scenic freeways were estimated to be more than 65 linear miles. An average daily water consumption of almost 3 mgd, or 45,000 gallons per mile, would be required for scenic landscaping on freeways.

From the Historical Collection of Title Insurance and Trust Company

Looking north over Mission Bay

Recommended are two reclamation plans, plan 1 and plan 2. In plan 1, a single waste water reclamation plant, at an overall project cost of $3,498,000, would be located in Mission Valley to serve both parks, Balboa and Mission Bay. The cost includes reclaimed water production facilities, storage facilities, and transmission and main distribution facilities for both parks. Variations considered in plan 1 resulted in cost estimates ranging from $3,335,000 to $3,552,000.

Plan 2 calls for a separate system for each park. The Tecolote Valley system, for Mission Bay Park, would cost $2,205,000, and the Chollas Valley system for Balboa Park, would cost $1,800,000. Location of plants for both plan 1 and plan 2 are shown on Plate 11. Flow diagrams for both plants are shown on Plate 12.

Costs, projected over a 40-year amortization period at 4 percent interest for structures and pipelines, and over a 20-year period at 4 percent for mechanical equipment, varied from $43 to $45 per acre-foot for plan 1 and from $52 to $53 per acre-foot for plan 2. The total irrigation demand over 40 years would be 265,780 acre-feet. Compared with not using reclaimed water, plan 1 would result in net savings of $23.8 million to the citizens of San Diego during 40 years or an average annual savings of $594,500.

San Diego County Subarea

The proposal has been made that 1 mgd of Escondido's sewage effluent be diverted from Escondido Creek to San Dieguito River to aid in inhibiting sea-water intrusion. This reclaimed water would cost from $11 to $22 per acre-foot, depending on the method of transport.

Potential Waste Water Reclamation Projects

Potential waste water reclamation projects are limited, in this report, to the San Diego metropolitan subarea only, because this is the only one of the three subareas from which waste water is discharged to the ocean.

Potential class A planned reclamation projects considered here are irrigation of golf courses, parks, and scenic freeways in the San Diego metropolitan subarea[21,22,23]. A list of selected potential projects with the estimated yearly irrigation water demand is given in Table 19.

TABLE 19

SELECTED POTENTIAL PROJECTS USING RECLAIMED WATER

Location	Use	Amount in acre-feet per year
El Cajon	Golf course	375
	Freeway landscaping	330
Mission Gorge	Park	900
Rose Canyon	Golf course	375
	Freeway landscaping	300
	Park	900
Spring Valley	Golf courses	600
TOTAL		3,780

Some of the places where potential class A waste water reclamation systems may be considered are El Cajon, Mission Gorge, Rose Canyon, and Spring Valley. El Cajon and the Spring Valley Sanitation District have existing sewage treatment plants suitable for reclamation. These plants have been abandoned because of connection with the San Diego Metropolitan Sewerage System. While they were in operation, effluent from the two plants was being used to irrigate golf courses and a ballpark.

A plant could be constructed in Mission Gorge to irrigate part of the Fortuna Mountain-Mission Gorge Metropolitan Park. In the Rose Canyon area, a plant could be constructed to irrigate a future golf course, future park, and future scenic freeways. Flow diagrams of these plants are shown on Plate 13.

El Cajon Waste Water Reclamation Plant

El Cajon's sewage treatment plant, with a design capacity of 2.8 mgd, can produce irrigation water at an average daily rate of 1.7 mgd. At present, the Fletcher Hills Golf Course has an average demand of about 0.34 mgd. The State Division of Highways has an average daily demand of about 0.30 mgd for freeway landscaping in the El Cajon-La Mesa area.

If $150,000 is assumed for the present value of the El Cajon plant with an estimated remaining useful life of 15 years, the cost of operating the plant, using 4 percent interest for the investment, would be $13,500 per year, or slightly more than $19 per acre-foot, based on a 0.64 mgd irrigation demand. Using Figure 7, operation costs would approximate $23 per acre-foot. This indicates that El Cajon could produce water at its sewage treatment plant for $42 per acre-foot for Fletcher Hills Golf Course and the Division of Highways. If a market could be found for a total of 1.7 mgd, the costs of reclaiming water at the plant site would drop from $42 to $25 per acre-foot. If the savings in waste water treatment charges currently being paid to the City of San Diego are considered, these figures can be reduced to $28 and $11, respectively.

As an alternate to the El Cajon plant, Santee County Water District can, in time, also supply reclaimed water to the El Cajon area.

Mission Gorge Waste Water Reclamation Plant

A waste water reclamation plant could be constructed to supply all or part of the irrigation requirements of the Fortuna Mountain-Mission Gorge Metropolitan Park in the Mission Gorge area. The waste water may be taken from the Mission Gorge trunk sewer if this water is of sufficient quantity and quality. This sewer was not in operation during the field sampling.

An estimated irrigation requirement of 900 acre-feet per year, or 0.8 mgd, may be needed for the Mission Gorge Park at present, and more may be needed in the future. Waste water may also be used for recreational lakes in the park area. A plant producing treated waste water for an irrigation demand of 1.0 mgd could be constructed at the park site to eliminate transmission lines. This plant would require a design flow of 1.65 mgd to allow for peak irrigation demand. It could be operated for about $65 per acre-foot to provide reclaimed water for park irrigation. If other uses of the treated waste water could be found for continuous operation of the plant at design flow, the cost would be reduced to about $45 per acre-foot. The approximate location of the plant is shown on Plate 11, and a flow diagram is shown on Plate 13.

Rose Canyon Waste Water Reclamation Plant

A water reclamation plant could be installed to satisfy irrigation requirements for a future golf course in Rose Canyon, a future park in San Clemente Canyon, and future freeway landscaping. The waste water may be taken from the Rose Canyon trunk sewer, which now has an average daily summer flow of about 2 mgd.

Irrigation requirements for the Rose Canyon area are estimated to be about 375 acre-feet per year for the golf course, 900 acre-feet per year for the park, and 300 acre-feet per year for freeway landscaping. This amounts to an average demand of about 1.4 mgd, with peak summer demands of 2.3 mgd. Flow volume in the Rose Canyon sewer is not yet sufficient to meet the irrigation demand, but the volume should be ample by the time the area is developed.

A reclamation plant to satisfy a 1.4 mgd irrigation demand could be constructed and operated for about $60 per acre-foot. For 2.3 mgd of reclaimed water, the cost would be reduced to $42 per acre-foot. The location of this plant is shown on Plate 11 and flow diagram on Plate 13.

Spring Valley Waste Water Reclamation Plant

The Spring Valley Sanitation District has abandoned its 1 mgd sewage treatment plant and has connected to the San Diego Metropolitan Sewerage System. During the 1962-63 fiscal year, the flow through the Spring Valley Sanitation District plant was 1.71 mgd of marginal quality sewage.

Bonita Valley Country Club, an 18-hole golf course, and Bonita Golf Course, a 9-hole golf course, are located in Sweetwater River Valley below the Spring Valley Sewage Treatment Plant. The 18-hole course requires about 400 acre-feet per year and the 9-hole course about 200 acre-feet per year. Irrigation demand for both courses would average about 0.54 mgd.

To recover its investment in the plant, the Spring Valley Sanitation District would have to charge about $47 per acre-foot for 0.54 mgd of reclaimed water at its plant site. This is based on $25 per acre-foot for operation costs and an estimated plant value of $180,000, using a 20-year usable life and 4 percent interest on the investment. Consideration of the savings on waste treatment charges presently being paid to the City of San Diego would reduce this cost to about $33.

The location of the proposed system is shown on Plate 11, and a flow diagram is shown on Plate 13.

Summary

To compare the costs of reclaimed waste water with costs of alternative supplies, it is necessary to use the same points of delivery for all alternative plans. These points were considered to be at the boundaries of the areas of use.

In preparing the preceding cost analyses, it is assumed that the net benefits resulting from the use of reclaimed water are identical with those resulting from use of other existing local conventional water supplies. Therefore, costs of water from reclamation plants serving previously listed beneficial purposes are compared with the cost of serving those purposes with existing conventional water supplies to determine the economic justification of waste water reclamation. It is also assumed that the agencies that will handle waste water reclamation are not necessarily the same agencies that presently handle water supplies. This being the case, the cost of reclaiming waste water would be compared with the consumer cost for conventional water supplies. In the San Diego Metropolitan area consumer costs for water vary from about $90 per acre-foot to about $150 per acre-foot. Reclamation costs are competitive with these costs.

Should an existing water supply agency desire to reclaim water as a supplement to its supply, a more detailed cost analysis would have to be made in order to confirm the economic justification. This cost analysis should include all water projects that the water supply agency is committed to. Although the Department recognizes the importance of considering each water agency separately in regard to the economic justification of waste water reclamation it is not the purpose of this report to make a detailed study of the economics of the various water supply agencies. It may be concluded that reclamation of waste water in coastal San Diego County appears feasible; however, more detailed studies are required to confirm the economic justification of each reclamation plant.

CHAPTER VI. SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The principal results of this investigation are summarized in the following findings, conclusions, and recommendations.

Summary of Findings

The findings of this investigation may be summarized as follows:

1. Surface and ground water resources in coastal San Diego County are not adequate to meet the current water demand. Therefore, water is also supplied from the Colorado River and from waste water reclamation. Approximately 85 percent of the water used is from the Colorado River. It is anticipated that water requirements by the year 2000 will be double the quantity presently used. For the future supply, all present sources will be used, and water will also be imported from Northern California through the State Water Project, now under construction, and existing facilities of The Metropolitan Water District of Southern California.

2. The beneficial uses of water in coastal San Diego County are domestic consumption; municipal use; commercial use; industrial use; and irrigation of agricultural lands, golf courses, parks, and freeway landscaping.

3. A total of 38 major waste disposal systems are in operation in coastal San Diego County. Of these, 10 are in Camp Pendleton Marine Corps Base (called Camp Pendleton subarea in the report), 4 are in the area

served by the San Diego Metropolitan Sewerage System (San Diego metropolitan subarea), and 24 are in the remainder of coastal San Diego County (San Diego County subarea).

4. In the 1962-63 fiscal year, about 72 million gallons per day (mgd) of waste water were produced in coastal San Diego County. Of this amount, more than 59 mgd came from the metropolitan subarea, 8.9 mgd from the county subarea, and the remainder from the Camp Pendleton subarea.

5. Of the 72 mgd of waste water discharged in the study area in 1962-63, approximately 73 percent, or 54 mgd, was discharged to the ocean. This entire discharge was from the San Diego metropolitan subarea. At all discharge sites in the county and Camp Pendleton subareas, reclamation of some kind occurs. In most cases, it is "involuntary reclamation", with waste water mingling with water from other sources, as in lakes, streams, or ground water basins. Other uses are for irrigation, ground water recharge, and decorative and recreational lakes.

6. Waste water flows in the study area consist of domestic wastes, industrial wastes, and water contributed to the sewerage system through infiltration.

7. The study reinforced earlier findings that the mineral quality of the water supply is the most significant factor in determining the quality of the waste water. Also contributing to this quality are the mineral pickup resulting from domestic and industrial use and the quality and quantity of infiltration waters.

8. Colorado River water is very hard and is between class 1 and class 2 as irrigation water. The local ground water supply is also very hard and is from class 2 to class 3 as irrigation water. The local surface water is moderately hard and is class 1 as irrigation water.

9. Approximately 41.2 mgd of waste water in the San Deigo metropolitan subarea, of which 40 mgd are being discharged to the ocean, are of a quality that is suitable for reclaiming for at least some beneficial uses. About 8.3 mgd of the waste water in the county subarea and 3 mgd of that in Camp Pendleton subarea are of a quality suitable for reclaiming.

10. The numerous waste water reclamation plants in coastal San Diego County reclaimed about 15,700 acre-feet in 1962-63 for various beneficial uses.

11. There are several potential waste water reclamation projects in the metropolitan subarea. For these projects, costs of reclaiming waste water would probably range from $11 to $65 per acre-foot at the plant site (depending on demand of the market). To this would be added storage and transmission costs of $3 to $14 per acre-foot; pumping costs of 0 to $8 per acre-foot. The total cost of reclaimed water prior to distribution would vary from about $14 to $87 per acre-foot. These costs do not include credits for fertilizer value and costs of using the Metropolitan Sewerage System, which would not be incurred if the waste water were reclaimed.

Conclusions

As a result of this investigation, the following conclusions were reached:

1. Because waste water discharged to the ocean is considered lost for beneficial uses, reclamation of this waste water would offer a new source of supply.

2. From the findings in this report, it appears that coastal San Diego County offers a market for reclaimed waste water and has sufficient waste water of suitable quality for reclamation. The present water agencies have adequate legal protection to undertake reclamation, and the cost of reclaimed water in many areas would be competitive with, or less than, the cost of present and future imported supplies. Thus, reclamation of waste water in coastal San Diego County appears feasible; however, more detailed studies are required to confirm the economic justification of each reclamation plant.

3. Because the metropolitan subarea is the only one from which waste water is being discharged to the ocean and is the one in which the largest supply of waste water is available and the greatest demand for water exists, it is the subarea in which additional waste water reclamation projects appear to be most desirable.

4. The addition of Northern California water to future supplies will upgrade the quality of the waste water in coastal San Diego County.

5. Reclaimed waste water in the San Diego coastal area may be used for ground water recharge, recreational lakes, gravel-washing, road construction, and irrigation of the following: selected crops, recreational areas, golf courses, parks, cemeteries, and scenic freeways.

6. Specific waste water reclamation projects that may be considered include a plant in the El Cajon-La Mesa area to supply irrigation water for a golf course and freeway landscaping; in the Mission Gorge area to supply irrigation water for a park; in the Rose Canyon area to supply irrigation water for a golf course, park, and freeway landscaping; and in the Spring Valley area to supply irrigation water for golf courses. In

two of these areas--El Cajon and Spring Valley--abandoned sewage treatment plants are available for conversion to this use, or the Santee Waste Water Reclamation Plant, which is already in existence, can be enlarged to supply the needs in the El Cajon area.

Recommendations

On the basis of these findings and conclusions, the following recommendations are offered:

1. Waste water reclamation in the San Diego coastal area should be increased to supplement the existing water supply to meet a portion of the future water requirements.

2. In the San Diego metropolitan area, consideration should be given to the reclamation of water from sewage presently being wasted to the Pacific Ocean. This reclaimed water would be for potential beneficial uses in the area.

3. Sewage treatment plants that have been abandoned because of the completion of the San Diego Metropolitan Sewerage System should be considered as potential waste water reclamation plants.

APPENDIX A

SELECTED REFERENCES

USED IN THIS INVESTIGATION

APPENDIX A

SELECTED REFERENCES
USED IN THIS INVESTIGATION

1. American Society of Civil Engineers. "Glossary of Water and Sewage Control Engineering". 1949.

2. Boyle Engineering, Consulting Engineers. "City of San Diego Water Reclamation Study for Balboa Park and Mission Bay Park". March 1963.

3. California Department of Finance. "California Population - 1963".

4. California Department of Public Health. "California Domestic Water Supply Statistics". 1958.

5. California Department of Public Works, Division of Water Resources. "Effects of Water Softener Regeneration Wastes, San Diego Region". December 1952.

6. ----. "Reclamation of Water From Sewage or Industrial Waste". December 1952.

7. ----. "Reclamation of Water From Sewage or Industrial Waste". June 1954.

8. California Department of Water Resources. "Investigation of Alternative Sites for Nuclear Powerplant and Sea-Water Conversion Plant". Office Report. March 1965.

9. ----. "Investigation of Alternative Aqueduct Routes to San Diego County". Bulletin No. 61. 1957.

10. ----. "Reclamation of Water from Sewage and Industrial Wastes". Bulletin No. 68, Progress Report, July 1, 1953 - June 30, 1955. January 1958.

11. ----. "Investigation of Alternative Aqueduct Systems to Serve Southern California". Bulletin No. 78. Appendix B, January 1959.

12. ----. "Investigation of Alternative Aqueduct Systems to Serve Southern California". Bulletin No. 78. Appendix D. "Economic Demand For Imported Water". March 1960.

13. ----. "Feasibility of Reclamation of Water from Wastes in the Los Angeles Metropolitan Area". Bulletin No. 80. December 1961.

14. California Department of Water Resources. "Reclamation of Water From Sewage and Industrial Wastes in California, July 1, 1955 - June 30, 1962". Bulletin No. 68-62. October 1963.

15. ----. "San Diego County Land and Water Use Survey, 1958". Bulletin No. 102. August 1963.

16. California Water Pollution Control Board. "Studies of Waste Water Reclamation and Utilization". Publication No. 9. 1954.

17. Holmes and Narver-Montgomery. "Basic Plan for the Collection, Treatment and Disposal of Sewage for the Metropolitan Area, San Diego, California". November 1958.

18. Logan, John A., et al. "An Analysis of the Economics of Waste Water Treatment". Journal Water Pollution Control Federation, Volume 34, No. 9. September 1962.

19. Rawn, A. M., et al. "Report on the Collection, Treatment and Disposal of the Sewage of San Diego County, California". September 1952.

20. ----. "North Coastal San Diego County Sewerage Survey". June 1960.

21. San Diego City Planning Department. "Fortuna-Mtn.-Mission Gorge Metropolitan Park". 1960.

22. ----. "The San Diego General Plan Study". December 1961.

23. ----. "Inventory of Park and Recreation Facilities in the San Diego Metropolitan Study Area". February 1962.

24. San Diego County Water Authority. Annual Reports 1946 to 1962.

25. San Diego City Utilities Department. "San Diego Sewerage Systems". July 1963.

26. United States Department of Agriculture. "The Quality of Water for Irrigation Use". Technical Bulletin 962. 1948.

27. ----. "Diagnosis and Improvement of Saline and Alkali Soils". Agriculture Handbook No. 60. February 1954.

28. United States Department of Commerce, Bureau of the Census. "Census Tracts, San Diego, California". 1960.

29. United States Department of the Interior, Office of Saline Water. "Saline Water Conversion". 1962.

APPENDIX B

DEFINITIONS OF TERMS

APPENDIX B

DEFINITIONS OF TERMS

Specialized words and terms used in this report are defined below. They are based on the "Glossary of Water and Sewage Control Engineering", 1949, published by the American Society of Civil Engineers.

Aeration - The bringing about of intimate contact between air and a liquid by one of the following methods: Spraying the liquid in the air, bubbling air through the liquid, or agitating the liquid to promote adsorption of air.

Clarifier - A tank or basin in which water, sewage, or other liquid containing settleable solids is retained for a sufficient time so that a part of the suspended matter is removed by gravity. Usually in sewage treatment, the detention period is short enough to avoid anaerobic decomposition. Also termed settling tank.

Comminutor (Also Barminutor) - A device for the cutting of coarse sewage solids into particles of sufficient fineness to pass through fine screen openings.

Complete Mineral Analysis - A determination of the concentration of the principal dissolved constituents of water (calcium, magnesium, sodium, potassium, hydroxide, bicarbonate, carbonate, chloride, sulfate, nitrate, boron, and fluoride). Such an analysis includes determinations of total dissolved solids, electrical conductance, and pH.

Complete Sewage Treatment (Secondary) - Combined sedimentation and biological treatment of sewage which produces a clear, stable, and well-oxidized effluent.

Detritor - A settling tank of short detention period designed to remove heavy settleable solids such as sand or gravel.

Digester - A tank in which the solids resulting from the sedimentation of sewage are stored for anaerobic decomposition.

Electrical Conductance - The reciprocal of the resistance in ohms measured between opposite faces of a centimeter cube of an aqueous solution at a temperature of 25° centigrade. This is generally expressed in micromhos/cm.

Imhoff Tank - A deep, two-storied sewage tank consisting of an upper or continuous flow sedimentation chamber, and a lower or sludge-digestion chamber.

Incidental Reclamation - A process wherein the recovery of waste waters for beneficial use is secondary to sewage treatment or disposal.

Industrial Waste - Defined in Section 13005 of the California Water Code as "... any and all liquid or solid waste substance, not sewage, from any producing, manufacturing or processing operation of whatever nature".

Involuntary Reclamation - The recovery for beneficial use of waste waters that have lost their identity through mixing with natural streamflow or ground water to which they were discharged.

Oxidation Pond - An artificial pond that provides an environment for living organisms, which, in the presence of oxygen, converts the organic matter contained in sewage to a more stable form.

pH - The logarithm, to the base 10, of the reciprocal of the hydrogen ion concentration, or more precisely, of the hydrogen ion activity in moles per liter.

Parshall Flume - A device for measuring the flow of liquid in an open conduit.

Planned Reclamation - Any process of recovery of water from waste waters that was originally planned and conceived for the primary purpose of putting the recovered water to beneficial uses.

Primary Sewage Treatment - Any process that removes a portion of the suspended and floating matter from sewage or industrial waste by screening, skimming, sedimentation, or other physical means.

Reclamation - The process of recovering water from sewage or industrial wastes so that the water may be put to beneficial use.

Safe Yield - The maximum dependable draft which can be made continuously upon a source of water supply (surface or ground water) during a period of years during which the probable driest period or period of greatest deficiency in water supply is likely to occur. Dependability is relative and is a function of storage provided and drought probability.

Secondary Sewage Treatment - Any process of sewage or industrial waste treatment that follows primary treatment, and that accomplishes further stabilization of organic matter by biological or chemical action.

Sewage - Defined in Section 13005 of the California Water Code as "... any and all waste substance, liquid or solid, associated with human habitation, or which contains or may be contaminated with human or animal excreta or excrement, offal, or any feculent matter".

Supernatant - The liquid overlying deposited solids.

Trickling Filter - A filter consisting of coarse material such as stones over which sewage is distributed, and through which it trickles to the underdrains, giving opportunity for the formation of zoogleal slimes which clarify and oxidize the sewage.

Waste Water - Water that has been put to some use or uses and has been disposed of commonly to a sewer or wasteway. It may be liquid industrial waste, or sewage, or both.

Water Requirement - The water needed to provide for all beneficial uses, whether consumptive or nonconsumptive, and for irrecoverable losses incidental to such uses.

APPENDIX C

DESCRIPTION OF WASTE WATER TREATMENT PLANTS IN COASTAL SAN DIEGO COUNTY

APPENDIX C

INDEX TO TREATMENT PLANTS

Page

APPENDIX C

DESCRIPTION OF WASTE WATER TREATMENT PLANTS IN COASTAL SAN DIEGO COUNTY

A general description of each sewage treatment plant in the study area, except for the San Diego Point Loma Treatment Plant, is given in this appendix. The Point Loma Treatment Plant is described in Chapter III. The descriptions include the degree of treatment practiced, number and type of units used to achieve that treatment, design capacity, actual flows handled, and point of disposal of the effluent.

For convenience, the plants are divided according to the three subareas: San Diego metropolitan subarea, San Diego County subarea, and Camp Pendleton subarea. The metropolitan subarea is further divided into plants that are now operational and plants that have been abandoned.

San Diego Metropolitan Subarea

Four sewage treatment facilities in the San Diego metropolitan subarea are now in operation and 12 have been abandoned. Three of the operational facilities and all those abandoned are described here.

Operational Facilities

The four facilities currently in operation are the Lakeside, Santee, San Ysidro, and Point Loma Sewage Treatment Plants. The Point Loma Plant is described in Chapter III. The other three are discussed here.

Lakeside Sewage Treatment Plant. The Lakeside Sewage Treatment Plant is a secondary treatment plant with a design capacity of 0.28 million gallons per day (mgd) and a present average daily flow of 0.15 mgd. The plant, which is operated by the Lakeside Sanitation District, consists of a barminutor, Parshall flume, rectangular primary clarifier, circular digester, sludge drying beds, and oxidation pond. It also has provisions for recirculation to the primary clarifier. The final effluent is discharged into three percolation beds in the San Diego River.

Expansion of the sewerage system continues at a high rate, and the capacity of the plant was reached by 1964. The Lakeside Sanitation District plans to enlarge the existing sewage treatment and disposal facilities to provide for a total future discharge of 1.0 mgd.

Santee Sewage Treatment Plant. The Santee Sewage Treatment Plant, which is operated by the Santee County Water District, provides secondary treatment for approximately 0.8 mgd. The design capacity of the plant is 2.0 mgd. The plant consists of a barminutor, clarifier, activated sludge unit, floating cover digester, oxidation pond, and sludge drying beds. The effluent from the oxidation pond is chlorinated and pumped to a percolation area where it is collected; from there, it flows by gravity to three lakes operated in a series. The final effluent is discharged to Sycamore Canyon Creek.

San Ysidro Sewage Treatment Plant. The San Ysidro Sewage Treatment Plant consists of a pumping station, chlorination facilities, and raw sewage lagoon. The final effluent percolates into the bed of the Tia Juana River. The average daily flow for the 1962-63 fiscal year was 0.35 mgd.

Operation of the plant for the San Ysidro Sanitation District was taken over by the City of San Diego on July 1, 1962. Plans call for connecting San Ysidro to the San Diego Metropolitan Sewerage System by 1965.

Abandoned Facilities

The 12 sewage treatment facilities in the San Diego metropolitan subarea that have been abandoned are described below.

Brown Field Sewage Treatment Plant. The Brown Field Sewage Treatment Plant, now under jurisdiction of the City of San Diego, is a secondary treatment facility with a design capacity of 0.22 mgd. The plant consists of a comminutor, primary Imhoff tank, trickling filter, secondary Imhoff tank, Parshall flume, chlorination facilities, and two sludge drying beds. The final effluent discharges into sand filter beds that overflow into a dry wash tributary to Tia Juana River. This plant is not being operated at present, although a very minor flow from the airfield is allowed to run through it.

Camp Elliot Sewage Treatment Plant. The Camp Elliot Sewage Treatment Plant, operated by the U. S. Navy, was abandoned on October 1, 1960. Prior to abandonment, the plant served the Camp Elliot Naval Reservation. The plant, which provides secondary treatment, has a design capacity of 2.0 mgd. The plant consists of two comminutors, two primary clarifiers, two primary high-rate trickling filters, a secondary filter, two secondary clarifiers, chlorination equipment, a Parshall flume, a chlorine contact chamber, two separate sludge digesters, and six sludge drying beds. During operation, the final effluent was discharged into a dry wash tributary to Murphy Canyon.

Chula Vista Sewage Treatment Plants. Chula Vista has two sewage treatment plants. The "G" Street plant is a primary treatment facility with a design capacity of 0.3 mgd. The average flow through the plant for 1962-63 fiscal year was 0.49 mgd. The plant consists of an Imhoff tank, a separate sludge digestion unit, and chlorination equipment. The final effluent was discharged to San Diego Bay through an outfall sewer.

The "J" Street plant is a primary treatment facility with a design capacity of 1.4 mgd. The average flow handled by the plant for the 1962-63 fiscal year was 2.69 mgd. The plant consists of a bar screen, lift pumps, two circular combination aeration-sedimentation tanks, a separate sludge digestion unit and drying beds, chlorination equipment, and a propellor-type meter with recorder. The final effluent was discharged into San Diego Bay.

The City of Chula Vista has been connected to the San Diego Metropolitan Sewerage System since September 1963. Plans are that the treatment plants will be destroyed.

<u>Coronado Sewer Outfalls</u>. The Coronado sewerage system consists of two outfalls to San Diego Bay. The "B" Street outfall has a design capacity of 1.73 mgd and the "K" Street outfall has a design capacity of 3.46 mgd.

Since September 1963, the Coronado sewerage system has been connected to the San Diego Metropolitan Sewerage System and the outfalls abandoned.

<u>El Cajon Sewage Treatment Plant</u>. The El Cajon Sewage Treatment Plant was designed to provide secondary treatment for a capacity of 2.8 mgd. The average daily flow handled by the plant for the fiscal year 1961-62 was 2.17 mgd and for the 1962-63 fiscal year was 2.51 mgd. The plant consists of a primary clarifier, which includes an annular outer aeration

chamber that is divided into preaeration, aeration, and reaeration sections, a secondary clarifier, two separate digesters with sludge drying beds, chlorination equipment, a chlorine contact tank, and a flow meter. The final effluent was discharged to Forrester Creek with approximately 0.5 mgd being used for irrigation of the Fletcher Hills golf course and 0.07 mgd for a ballpark.

The City of El Cajon connected to the San Diego Metropolitan Sewerage System in September 1963 and the treatment plant was shut down. Plans include an economic study to determine the possibility of reactivating the plant as a waste water reclamation plant.

Gillespie Field Sewage Treatment Plant. The Gillespie Field Sewage Treatment Plant, operated by Gillespie Field Sanitation District, is a secondary treatment facility with a design capacity of 0.25 mgd. The treatment plant was built to handle flows from Gillespie Field only and in 1961-62 had an average daily flow of 0.04 mgd. The plant consists of a comminutor, primary clarifier, filter, secondary clarifier, separate sludge digester and sludge drying beds, Parshall flume, chlorination facilities, and percolation beds. The final effluent was discharged to a drainage ditch which flows into Forrester Creek.

As of September 1, 1963, the waste water flows from Gillespie Field will be transported to the Metropolitan Sewerage System and the plant abandoned.

Imperial Beach Sewage Treatment Plant. The Imperial Beach Sewage Treatment Plant has a design capacity of 0.45 mgd. The plant afforded secondary treatment to an average flow of 0.85 mgd during the

1960-61 fiscal year. The plant consists of an Imhoff tank, a trickling filter, a secondary clarifier, a Parshall flume, two oxidation ponds, and eight sludge drying beds. Disposal of the final effluent was normally by evaporation and percolation from a lagoon.

As of September 1, 1963, the Imperial Beach sewerage system has been connected to the San Diego Metropolitan Sewerage System, and the sewage treatment plant has been abandoned and, according to information at hand, will be destroyed.

International Sewer Outfall. The International Sewer Outfall, which was under jurisdiction of the International Boundary and Water Commission, was sealed and abandoned on July 10, 1962. Prior to its abandonment, the outfall transported sewage from Tijuana (Baja California) and San Ysidro (California) to the Pacific Ocean at the mouth of the Tia Juana River. The average flow during the 1960-61 fiscal year was 3.8 mgd and for the 1961-62 fiscal year was 1.92 mgd.

Palm City Sewage Treatment Plant. The Palm City Sewage Treatment Plant, operated by Palm City Sanitation District, is a secondary treatment facility with a design capacity of 1.70 mgd. The plant consists of a barminutor, Parshall flume, primary clarifier, high-rate trickling filter, secondary clarifier, separate sludge digestion unit, and three oxidation ponds. The final effluent is discharged into the Otay River.

Palm City has been connected to the San Diego Metropolitan Sewerage System since the first of September 1963. Plans indicate that the Palm City Sewage Treatment Plant will be destroyed.

Ream Field Sewage Treatment Plant. The Ream Field Sewage Treatment Plant, serving the U. S. Naval Auxiliary Air Station, has a design capacity of 0.45 mgd. The plant provided primary treatment with equipment consisting of a comminutor, primary clarifier, Parshall flume, chlorine contact tank, sludge digester, and four sludge drying beds. The final effluent was discharged into the Tia Juana River.

The sewage from Ream Field is now routed through Imperial Beach to the San Diego Metropolitan Sewerage System. The plant has been abandoned since September 1, 1963. Plans indicate that the plant will be destroyed.

San Diego Harbor Drive Sewage Treatment Plant. The Harbor Drive Plant (Bay Plant) is a primary treatment plant with a design capacity of 40 mgd. The plant, which was operated by the City of San Diego, consists of a mechanical bar screen, four raw sewage pumps, two combined aeration-sedimentation tanks with each aeration unit containing a detritor and grit chamber, chlorination facilities, four heated primary digesters, and two heated secondary digesters. The digested sludge was transported to Mission Bay Park and the final effluent was discharged to San Diego Bay.

Spring Valley Sewage Treatment Plant. The Spring Valley Sewage Treatment Plant is a secondary treatment facility with a design capacity of 1.0 mgd. The average flow for the 1962-63 fiscal year was 1.71 mgd. The plant consists of a barminutor, Parshall flume, primary clarifier, separate sludge digester, two high-rate trickling filters, and secondary clarifier. The final effluent was chlorinated, discharged to Sweetwater Creek, and subsequently used to irrigate a golf course.

The Spring Valley Sanitation District connected its sewerage system to the San Diego Metropolitan Sewerage System on September 1, 1963, and the treatment plant was abandoned. Plans indicate that the treatment plant will be maintained for two years for possible reactivation as a waste water reclamation plant.

San Diego County Subarea

The 24 sewage treatment plants in the San Diego County subarea are described below.

Alpine Sewage Treatment Plant

The Alpine Sewage Treatment Plant is an intermediate treatment facility operated by the Alpine Sanitation District. The plant has a design capacity of 0.07 mgd, and during the 1962-63 fiscal year handled an average flow of 0.01 mgd. The facility consists of a bar screen, primary clarigester unit which combines sedimentation and digestion, and oxidation ponds in series. Final discharge of the effluent is to Alpine Creek.

Possible expansion of the sewerage system is being studied by the County Department of Public Works.

Callan Sewage Treatment Plant

The Callan Sewage Treatment Plant, operated by San Diego, serves the La Jolla Farms subdivision, Torrey Pines Golf Course and Inn, General Atomic Division of General Dynamics, and the Salk Institute for Biological Studies. The plant flows averaged 0.30 mgd during the 1962-63 fiscal year; the effluent was used to irrigate the grounds of the laboratory of the General Atomic Division. The facility provides intermediate treatment in the form of oxidation ponds plus chlorination. The design capacity of the plant is 1.0 mgd.

Cardiff Sewage Treatment Plant

The Cardiff Sewage Treatment Plant serves the community of Cardiff-by-the-Sea, plus a small portion of Encinitas. The plant, operated by the Cardiff Sanitation District, has a design capacity of 0.44 mgd. The average flow handled by the plant during the 1962-63 fiscal year was 0.3 mgd. The plant provides secondary treatment by means of a primary clarifier, sludge digester, aeration tanks, and oxidation pond. The final effluent is discharged into San Elijo Lagoon.

Plans indicate that the construction of a joint sewage treatment plant with the Solana Beach Sanitation District, with an ocean outfall, would be desirable.

Carlsbad Sewage Treatment Plant

The City of Carlsbad is served by a secondary treatment plant with a design capacity of 0.6 mgd. During the 1961-62 fiscal year, the plant treated an average flow of 0.47 mgd from a service area of 15 square miles. The plant consists of an influent pumping station, chlorination facilities, Imhoff tank, two sludge drying beds, standard-rate trickling filter, two secondary clarifiers, and effluent holding pond. The final effluent is pumped to Buena Vista Lagoon (Brown Bird Sanctuary).

Plans call for uniting with the Vista Sanitation District for construction of a joint treatment plant to be completed in 1965.

Del Mar Sewage Treatment Plant

The Del Mar Sewage Treatment Plant, which is operated by Del Mar Utilities, is a secondary treatment facility with a design capacity of 0.25 mgd. The plant consists of an influent pumping station, primary aeration-sedimentation tank, sludge digester, a chlorine contact chamber, and three oxidation ponds. The final effluent is discharged into the San Dieguito River. During the 1962-63 fiscal year, the plant treated and disposed of an average flow of 0.20 mgd. No plans for the future have yet been made.

Encinitas Sewage Treatment Plant

The Encinitas Sewage Treatment Plant is a secondary treatment facility operated by the Encinitas Sanitary District. The plant has a design capacity of 0.25 mgd, and the average flow for the 1961-62 fiscal year was 0.30 mgd. Treatment units include an Imhoff tank, sludge drying beds, a standard-rate trickling filter, a secondary clarifier, and an oxidation pond. The final effluent is discharged to a farm for irrigation of flowers.

Plans are to enlarge the existing facilities with no change in the point of effluent discharge.

Escondido Sewage Treatment Plants

Escondido is served by two secondary sewage treatment plants, which discharge to Escondido Creek. The old plant has a design capacity of 0.8 mgd and, during the 1962-63 fiscal year, treated an average flow of 0.69 mgd. It consists of an influent pumping station, four primary clarifiers, a standard-rate trickling filter, three secondary clarifiers, a chlorine contact tank, and three sludge digesters.

The newer plant has a design capacity of 1.0 mgd and, for the 1962-63 fiscal year, treated 0.78 mgd. The plant consists of an influent pumping station, primary clarifier, aeration tank, secondary clarifier, two chlorine contact tanks, and one digester. Although the present design capacity is 1.0 mgd, the plant is designed so that additional units can be added to bring the capacity up to 4.0 mgd. Construction was begun in 1963 on additional units to increase the design capacity to 3.0 mgd. Upon completion of these additional facilities to the newer plant, the older sewage treatment plant will be abandoned.

Fallbrook Sewage Treatment Plant

The Fallbrook Sewage Treatment Plant is a secondary treatment facility which serves an area of about 5 square miles. The plant, operated by the Fallbrook Sanitary District, has a design capacity of 0.50 mgd and for the 1962-63 fiscal year had an average flow of 0.25 mgd. The plant consists of a bar screen, a pumping station, an Imhoff tank, four sludge drying beds, a Parshall flume, a high-rate trickling filter, and three oxidation ponds operated in series. The plant effluent overflows into Fallbrook Creek; part of the effluent is used to irrigate fruit trees.

The "North Coastal San Diego County Sewerage Survey" (20)* has recommended the use of the existing plant to treat sewage originating in the Santa Margarita drainage basin and the construction of a new plant for sewage originating in the San Luis Rey drainage basin.

Julian Sewage Treatment Plant

Waste treatment facilities operated by the Julian Sanitation District consist of a septic tank with a design capacity of 0.05 mgd

*Reference 20 in Appendix A.

followed by further treatment of the supernatant in three oxidation ponds. The average flow of this system during the 1962-63 fiscal year was 0.01 mgd.

Leucadia Sewage Treatment Plant

The Leucadia Sewage Treatment Plant uses secondary treatment consisting of a barminutor, primary clarifier, trickling filter, final clarifier, and chlorine contact chamber. The design capacity of the plant is 1.0 mgd and the average flow handled was 0.008 mgd for March through June 1963. The final effluent is discharged into percolation ponds above the Los Batiquitos Lagoon in San Marcos Creek. The plant is operated by the Leucadia County Water District.

Oceanside Sewage Treatment Plants

Oceanside is served by three sewage treatment plants, all of which discharge to Whelan Lake. The older plant, located on Tait Street, is a primary treatment facility with a 4.0 mgd design capacity. The average flow through the plant for the 1962-63 fiscal year was 2.29 mgd. The plant consists of a comminutor and bar screen, two primary clarifiers, a gas chlorinator, and two heated digesters.

The San Luis Rey plant is also a primary treatment facility, with a design capacity of 1.85 mgd. The average flow handled by the plant during the 1962-63 fiscal year was 0.03 mgd. The plant consists of an influent pumping station, a bar screen and comminutor, two combined aeration, sedimentation tanks, a floating cover digester, and an effluent pumping station.

The Buena Vista plant is a secondary treatment facility with comminution, primary clarification, aeration, and secondary clarification facilities.

Pomerado Sewage Treatment Plant

The Pomerado Sewage Treatment Plant was built in 1958 to serve Poway Valley and is operated by the Pomerado County Water District. The plant provides secondary treatment for a peak design capacity of 0.56 mgd and during the 1962-63 fiscal year treated an average flow of 0.39 mgd. The plant consists of a bar screen, primary clarifier, standard rate trickling filter, secondary clarifier, and chlorine contact tank. The final effluent is discharged to Los Penasquitos Creek.

Future plans indicate expansion in stages to an ultimate design capacity of 1.12 mgd.

Ramona Sewage Treatment Plant

The Ramona Sewage Treatment Plant, operated by the Ramona Sanitation District, has a design capacity of 0.3 mgd and for the 1962-63 fiscal year treated an average flow of 0.10 mgd. The plant is a secondary treatment facility and includes an Imhoff tank, sludge digester, standard-rate trickling filter, secondary clarifier, oxidation pond, and holding pond for irrigation of sheep pasture.

Rancho Bernardo Sewage Treatment Plant

The Rancho Bernardo Sewage Treatment Plant was completed and its operation transferred to the City of San Diego in 1963. The plant is specifically designed for waste water reclamation. It has a design capacity of 0.5 mgd and consists of a comminutor, aeration unit, chlorine contact chamber, and two holding ponds. Average flow from the plant is about 0.1 mgd. The final effluent is reclaimed for irrigating the Rancho Bernardo golf course.

Plans indicate that three similar treatment plants, each with a design capacity of 2.0 mgd, will be constructed to handle the expected population of the community in 1970.

Rancho del Campo Sewage Treatment Plant

The Rancho del Campo Sewage Treatment Plant, operated by the County of San Diego, is a secondary treatment facility with a design capacity of 0.51 mgd. During the 1962-63 fiscal year, the plant treated and disposed of a 0.04 mgd average flow. Treatment equipment consists of a bar screen, two Imhoff tanks, two chlorine contact tanks, a trickling filter, two intermittent sand filters, and two final clarifiers. The final effluent is discharged to Campo Creek.

Rancho Santa Fe Sewage Treatment Plant

The Rancho Santa Fe Sewage Treatment Plant, operated by Rancho Santa Fe Sanitation District, consists of an extended aeration type of activated sludge treatment. The design capacity is 0.1 mgd with an average flow of 0.05 mgd during the 1962-63 fiscal year. The plant consists of a barminutor, aeration tank, secondary clarifier, and percolation ponds. The final effluent flows into the percolation ponds where it infiltrates into the ground water basin.

San Marcos Sewage Treatment Plant

San Marcos is served by a secondary sewage treatment plant with a design capacity of 0.10 mgd. The plant, which is operated by the San Marcos County Water District, consists of a comminutor and "rated aeration" package plant composed of an aeration chamber and final settling tank. The final effluent is discharged to San Marcos Creek.

Plans show that, within the next five years, the plant will be expanded to a 0.40 mgd capacity. The average flow of 0.17 mgd for the 1962-63 fiscal year is well above the present design capacity.

Solana Beach Sewage Treatment Plant

The Solana Beach Sewage Treatment Plant is a secondary treatment facility operated by the Solana Beach Sanitation District. The plant has a design capacity of 0.18 mgd and for the 1962-63 fiscal year treated an average flow of 0.20 mgd. The plant consists of a bar screen, Imhoff tank, standard-rate trickling filter, sludge digester, and two oxidation ponds in series. The final effluent is discharged to San Elijo Lagoon.

Plans are to construct a joint sewage treatment plant in conjunction with the Cardiff Sanitation District because of plant overload and restrictions on the effluent discharge imposed by the regional water quality control board.

Sorrento Sewage Treatment Plant

The Sorrento Sewage Treatment Plant is an intermediate treatment facility operated by the City of San Diego to serve the Sorrento Industrial Park. The plant has a capacity of 0.6 mgd and during the 1962-63 fiscal year treated an average flow of 0.2 mgd. Treatment units consist of a bar screen and comminutor, grit chamber, primary clarifier, chlorination facilities, sludge digester, and oxidation pond. The final effluent is discharged to Los Penasquitos Creek.

Plans include expansion of the treatment plant to an ultimate capacity of 1.2 mgd as soon as flow warrants the construction.

Valle Verde Sewage Treatment Plant

The Valle Verde Sewage Treatment Plant is a secondary treatment facility operated by the Valle Verde Community Services District. The plant has a design capacity of 0.3 mgd and consists of a bar screen, primary settling tanks, two aeration units, a chlorine contact chamber, and holding ponds. The final effluent will be used for irrigation of a golf course.

Viejas Honor Camp Sewage Treatment Plant

The Viejas Honor Camp Sewage Treatment Plant, operated by the Department of Honor Camps of the County of San Diego, consists of a "rated aeration" package-type plant. The plant provides secondary treatment for a design capacity of 0.02 mgd and an actual flow of 0.01 mgd during the 1962-63 fiscal year. The plant effluent is discharged to a tributary of the Sweetwater River.

Vista Sewage Treatment Plant

The Vista Sewage Treatment Plant consists of two separate treatment units on one site, operated by the Vista Sanitation District. The average flow handled by this plant for the 1962-63 fiscal year was 1.11 mgd. The older unit has a design capacity of 0.9 mgd. It consists of an Imhoff tank, standard-rate trickling filter, and final clarifier. The newer unit consists of a barminutor, primary clarifier, sludge digester, high-rate trickling filter, and two oxidation ponds for additional treatment. The older and newer units together have a design capacity of 1.1 mgd. The final effluent is discharged into Buena Vista Creek.

The capacity of the Vista Sewage Treatment Plant was reached in 1960. Studies by the San Diego County Public Works Department indicate that the best solution is to construct a joint sewage treatment plant with the City of Carlsbad. The plant will be located adjacent to the ocean, and the effluent will be disposed of by ocean outfall. Plans have been prepared and the plant is expected to be completed during 1965.

Camp Pendleton Subarea

The 10 existing sewage treatment plants in the Camp Pendleton Subarea are described below.

Camp Pendleton Sewage Treatment Plant No. 1

Camp Pendleton Sewage Treatment Plant No. 1 is a secondary treatment facility. The plant has a design capacity of 1.0 mgd and, for the 1962-63 fiscal year, treated an average flow of 0.62 mgd. Treatment units include a bar screen, a grit chamber, a primary clarifier, two trickling filters, a secondary clarifier, a two-stage digester, and chlorination facilities. The final effluent is discharged to a 12-million gallon holding pond, which is used for a fish hatchery, and the pond overflow discharges to Lake O'Neill.

Camp Pendleton Sewage Treatment Plant No. 2

Camp Pendleton Sewage Treatment Plant No. 2 is a secondary treatment facility. The plant has a design capacity of 0.8 mgd and, during the 1962-63 fiscal year, treated an average flow of 0.63 mgd. Treatment units include a bar screen, a grit chamber, primary and secondary clarifiers, two trickling filters, a single-stage sludge digester, and chlorination facilities. The final effluent is discharged to holding ponds from which part of the flow is used for golf course irrigation and the remainder is discharged to the Santa Margarita River drainage basin for recharge of ground water basins.

Camp Pendleton Sewage Treatment Plant No. 3

Camp Pendleton Sewage Treatment Plant No. 3 is a secondary treatment facility with a design capacity of 0.6 mgd. During the 1962-63 fiscal year, the plant treated and disposed of an average flow of 0.37 mgd. Treatment units consist of a bar rack, grit chamber, two primary clarifiers, two trickling filters, oxidation pond, a primary and a secondary digester, and chlorination facilities. The final effluent is discharged to the Santa Margarita River for recharge.

Camp Pendleton Sewage Treatment Plants Nos. 4, 5, and 6

Operation of Camp Pendleton Sewage Treatment Plants No. 4, 5, and 6 was discontinued in 1959.

Camp Pendleton Sewage Treatment Plant No. 8

Camp Pendleton Sewage Treatment Plant No. 8 is a secondary treatment facility. The plant has a design capacity of 0.42 mgd and, during the 1962-63 fiscal year, treated and discharged an average flow of 0.27 mgd. Treatment units include a bar screen, a grit chamber, primary clarifier, sludge digester, oxidation pond, and chlorination facilities. The final effluent is discharged into the Santa Margarita River for recharge of ground water basins.

Camp Pendleton Sewage Treatment Plant No. 9

The Camp Pendleton Sewage Treatment Plant No. 9 is a secondary treatment facility with a design capacity of 0.58 mgd. The plant consists of a bar screen, grit chamber, primary clarifier, sludge digester, oxidation ponds, and chlorination facilities. The plant effluent is discharged to a creek bed in Los Pulgas Canyon. Waste water flow for 1963-64 was 0.296 mgd.

Camp Pendleton Sewage Treatment Plant No. 10

Camp Pendleton Sewage Treatment Plant No. 10 provides secondary treatment at a design capacity of 0.37 mgd. Actual flow during 1963-64 was 0.158 mgd. Treatment units consist of a bar screen, grit chamber, primary clarifier, sludge digester, chlorination facilities, and oxidation ponds. The final effluent overflows into San Onofre Creek.

Camp Pendleton Sewage Treatment Plant No. 11

Camp Pendleton Sewage Treatment Plant No. 11 has a design capacity of 0.85 mgd. Waste water flow during 1963-64 was 0.269 mgd. The plant, which provides secondary treatment, consists of a bar screen, grit chamber, primary clarifiers, sludge digester, oxidation ponds, secondary clarifier, and chlorination facilities. The final effluent discharges to San Onofre Creek.

Camp Pendleton Sewage Treatment Plant No. 12

Camp Pendleton Sewage Treatment Plant No. 12 provides secondary treatment at a design capacity of 0.58 mgd. Waste water flow during 1963-64 was 0.383 mgd. The plant consists of a bar screen, grit chamber, primary clarifier, sludge digester, chlorination facilities, and oxidation ponds. The final effluent overflows to San Mateo Creek.

Camp Pendleton Sewage Treatment Plant No. 13

Camp Pendleton Sewage Treatment Plant No. 13 is a secondary treatment facility with a design capacity of 0.95 mgd. During the 1962-63 fiscal year, the plant treated and discharged an average flow of 0.41 mgd. Treatment units include a bar screen, grit chamber, primary clarifier, sludge digester, chlorination facilities, and oxidation ponds. The final effluent is discharged into the Santa Margarita River.

Fallbrook Naval Reservation Sewage Treatment Plant

The Fallbrook Naval Reservation Sewage Treatment Plant, serving the Fallbrook Naval Ammunition Depot, provides primary treatment and chlorination at a design capacity of 0.33 mgd. During the 1962-63 fiscal year, the plant treated an average flow of 0.03 mgd. Treatment units include a comminutor, Imhoff tank, and chlorination facilities. The final effluent discharges into a dry wash, tributary to Fallbrook Creek.

APPENDIX D

QUANTITY AND QUALITY OF SEWAGE DISCHARGED IN COASTAL SAN DIEGO COUNTY

TABLE D-1

HISTORICAL QUANTITIES OF SEWAGE DISCHARGED IN THE
SAN DIEGO METROPOLITAN SUBAREA

Facility	Flow given in million gallons per day / acre-feet per year								
	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	1963-64
Camp Elliot Sewage Treatment Plant	-- --	-- --	0.17 190	0.13 146	0.13 146	0.00 0.00	0.00 0.00	0.00 0.00	-- --
Chula Vista "G" Street Plant	-- --	-- --	0.60 672	0.60 672	0.60 672	0.46 516	0.35 392	0.49 549	-- --
"J" Street Plant	-- --	1.71 1,920	1.66 1,860	1.90 2,130	2.15 2,414	2.35 2,635	2.80 3,133	2.69 3,008	-- --
Coronado "B" Street Outfall	-- --	1.26 1,412	-- --	-- --	-- --	-- --	0.39 437	0.39 437	-- --
"K" Street Outfall	-- --	-- --	-- --	-- --	-- --	-- --	0.86 963	0.86 963	-- --
El Cajon Sewage Treatment Plant	0.78 881	1.04 1,166	1.48 1,656	2.04 2,286	2.09 2,346	2.06 2,303	2.30 2,582	2.51 2,810	-- --
Gillespie Field Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.02 23	0.03 34	0.04 45	0.03 34	-- --
Imperial Beach Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.80 900	0.85 950	-- --	-- --	-- --
International Sewer Outfall	3.48 3,912	3.72 4,171	4.45 4,985	4.45 4,980	4.38 4,922	3.80 4,206	1.92 2,151	0.00 0.00	0.00 0.00
Lakeside Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.04 46	0.04 46	0.15 168	0.18 202	0.23 259
Palm City Sewage Treatment Plant	-- --	-- --	-- --	0.46 516	0.61 682	0.75 840	0.79 885	0.87 975	-- --
Ream Field Sewage Treatment Plant	-- --	-- --	0.20 224	0.22 242	0.09 101	0.08 90	0.12 134	0.12 134	-- --
San Diego Harbor Drive Plant	39.90 44,786	42.50 47,648	44.60 49,914	45.80 51,357	47.90 53,683	47.80 53,582	48.80 54,650	48.00 53,767	-- --
Santee Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.45 509	0.56 628	0.85 952	0.80 896	0.85 948
San Ysidro Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.20 224	0.20 224	0.30 336	0.30 336	0.26 288
Spring Valley Sewage Treatment	-- --	-- --	-- --	0.79 885	1.26 1,414	1.23 1,378	1.56 1,748	1.71 1,915	-- --

TABLE D-2

TRUNK SEWER FLOWS,
SAN DIEGO METROPOLITAN SUBAREA

Trunk sewer	Flow given in million gallons per day / acre-feet per year		
	August 2-3, 1956	July 9-16, 1958	July 16-20, 1962
Balboa	0.90 / 1,010	1.60 / 1,790	2.60 / 2,920
Cabrillo	-- / --	0.52 / 580	0.30 / 360
East San Diego	7.60 / 8,470	6.40 / 7,170	12.60 * / 14,120
Encanto	-- / --	1.60 / 1,790	2.90 / 3,260
La Jolla	-- / --	3.10 / 3,470	4.30 / 4,850
Linda Vista	-- / --	0.86 / 960	-- / --
Mission Valley	2.30 / 2,600	2.70 / 3,020	3.20 / 3,550
Murray Canyon	-- / --	0.75 / 840	-- / --
National City	-- / --	1.45 / 1,620	-- / --
Rose Canyon	-- / --	0.30 / 340	2.20 * / 2,460

*May be in error due to backwater curves or other conditions at sampling point

TABLE D-3

HISTORICAL QUANTITIES OF SEWAGE DISCHARGED IN THE
SAN DIEGO COUNTY SUBAREA

Flow given in million gallons per day / acre-feet per year

Facility	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	1963-64
Alpine Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.01 / 11	0.01 / 11	0.01 / 11	0.01 / 11	0.02 / 22
Callan Sewage Treatment Plant	-- / --	-- / --	-- / --	0.04 / 45	-- / --	-- / --	0.24 / 268	0.30 / 336	0.33 / 374
Cardiff Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	-- / --	0.21 / 235	0.28 / 312	0.30 / 336	0.37 / 418
Carlsbad Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.60 / 672	0.60 / 672	0.47 / 526	0.47 / 526	0.45 / 505
Del Mar Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	-- / --	0.18 / 202	0.18 / 202	0.20 / 224	0.24 / 266
Encinitas Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	-- / --	-- / --	0.30 / 336	0.30 / 336	-- / --
Escondido Old plant	0.63 / 706	0.68 / 760	1.04 / 1,165	-- / --	1.13 / 1,271	0.58 / 649	0.71 / 798	0.69 / 773	-- / --
New plant	-- / --	-- / --	-- / --	-- / --	-- / --	0.55 / 620	0.68 / 761	0.78 / 874	1.64 / 1,843
Fallbrook Sewage Treatment Plant	-- / --	-- / --	0.16 / 179	0.17 / 190	0.27 / 302	-- / --	-- / --	0.25 / 280	0.30 / 336
Julian Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	-- / --	0.01 / 11	0.01 / 11	0.01 / 11	0.01 / 11
Oceanside Sewage Treatment Plant*	1.60 / 1,798	1.58 / 1,775	1.83 / 2,053	1.83 / 2,053	2.12 / 2,373	2.17 / 2,555	2.41 / 2,704	2.59 / 2,901	2.64 / 3,026
Pomerado Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.12 / 134	0.21 / 235	0.39 / 437	0.31 / 437	0.41 / 460
Ramona Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.07 / 79	0.07 / 79	0.06 / 67	0.10 / 110	0.10 / 110
Rancho del Campo Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.04 / 45	0.04 / 45	0.04 / 45	0.04 / 45	-- / --
Rancho Santa Fe Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	-- / --	0.02 / 22	0.04 / 45	0.05 / 56	0.05 / 56
San Marcos Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.04 / 45	0.07 / 79	0.07 / 79	0.17 / 190	0.16 / 178
Solana Beach Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.17 / 192	0.15 / 168	0.15 / 168	0.20 / 224	0.24 / 269
Vista Sewage Treatment Plant	-- / --	-- / --	-- / --	0.86 / 963	1.02 / 1,145	0.99 / 1,110	1.16 / 1,298	1.11 / 1,240	1.12 / 1,252

*The flows from Oceanside's three plants are combined here because both discharge to the same point (Whelan Lake).

TABLE D-4

HISTORICAL QUANTITIES OF SEWAGE DISCHARGED IN THE
CAMP PENDLETON SUBAREA

Facility	Flow given in million gallons per day / acre-feet per year								
	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	1963-64
Camp Pendleton Plant No. 1	1.03 / 1,161	0.71 / 795	0.79 / 885	0.66 / 740	0.63 / 706	0.67 / 751	0.67 / 751	0.62 / 694	0.57 / 639
Plant No. 2	0.66 / 740	0.73 / 818	0.66 / 740	0.66 / 740	0.61 / 685	0.62 / 694	0.66 / 740	0.63 / 706	0.65 / 723
Plant No. 3	0.63 / 706	0.55 / 616	0.52 / 582	0.42 / 471	0.37 / 415	0.30 / 336	0.31 / 347	0.37 / 415	0.32 / 353
Plant No. 4*	0.07 / 75	0.08 / 90	0.07 / 75	0.08 / 90	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	-- / --
Plant No. 5*	0.22 / 246	0.20 / 224	0.21 / 235	0.22 / 246	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	-- / --
Plant No. 6*	0.07 / 75	0.06 / 67	0.06 / 67	0.06 / 67	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	-- / --
Plant No. 8	0.24 / 269	0.23 / 258	0.23 / 258	0.22 / 246	-- / --	-- / --	-- / --	-- / --	0.25 / 275
Plant No. 9	0.27 / 302	0.36 / 403	0.32 / 358	0.28 / 314	-- / --	-- / --	-- / --	-- / --	0.25 / 275
Plant No. 10	0.12 / 134	0.12 / 134	0.12 / 134	0.15 / 168	-- / --	-- / --	-- / --	-- / --	0.14 / 156
Plant No. 11	0.31 / 347	0.37 / 414	0.19 / 213	0.16 / 179	-- / --	-- / --	-- / --	-- / --	0.27 / 304
Plant No. 12	0.30 / 336	0.33 / 370	0.25 / 280	0.22 / 246	-- / --	-- / --	-- / --	-- / --	0.38 / 426
Plant No. 13	0.23 / 258	0.22 / 246	0.18 / 202	0.33 / 370	0.45 / 504	0.38 / 426	0.44 / 483	0.41 / 459	0.37 / 414
Fallbrook Naval Reservation Sewage Treatment Plant	-- / --	-- / --	0.26 / 290	-- / --	-- / --	-- / --	0.03 / 34	0.03 / 34	0.04 / 45

*This plant was discontinued in 1959.

TABLE D-5

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE SAN DIEGO METROPOLITAN SUBAREA

Property*	Chula Vista "G" Street plant	Chula Vista "J" Street plant	Coronado "B" Street outfall	Coronado "K" Street outfall	El Cajon plant	Gillespie Field plant	Imperial Beach plant
Treatment	Primary	Primary	None	None	Aeration	Trickling filter	Trickling filter & lagoon
Date sampled	6-20-60 6-21-60	5-9-62	6-20-60	6-20-60	5-9-62	7-19-62	7-18-62
pH	7.4	7.3	8.6	7.3	7.2	7.7	7.8
EC x 10^6 at 25° C.	1,791	2,155	1,209	2,150	2,374	1,600	15,250
Calcium	75	77	66	70	82	73	230
Magnesium	39	37	27	47	54	30	388
Sodium	189	271	93	276	304	195	3,100
Potassium	14	17	5	14	19	20	330
Ammonium	25	93	23	0.0	77	4	2
Carbonate	0.0	0.0	3.0	0.0	0.0	0.0	0.0
Bicarbonate	295	783	86	75	433	128	310
Sulfate	309	108	323	326	308	174	931
Chloride	197	283	94	395	381	238	5,754
Nitrate	0.0	0.0	2.0	26	0.0	67	0.0
Fluoride	3	0.75	0.4	0.2	1.8	6.2	0.4
Boron	1	1	0	0.2	1	3.5	2
Silica	36	--	9	32	16	13	31
Total dissolved solids	1,200	1,610	785	1,365	1,690	1,004	11,028
Total hardness as $CaCO_3$	349	345	275	371	355	309	2,168
Noncarbonate hardness as $CaCO_3$	107	0.00	200	309	71	204	1,914
Organic Nitrogen as N	18	--	20	1.0	--	12	9
Nitrite as N	0.0	--	0.1	0.1	--	0.3	0.0
Orthophosphate	37	90	3	1	56	0.0	8
ABS detergents	--	--	--	--	--	0.9	7
Percent sodium	48	49	37	61	50	55	72

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE SAN DIEGO METROPOLITAN SUBAREA
(continued)

Property*	Lakeside plant	Palm City plant	Ream Field plant	San Diego Harbor Drive plant	San Diego Point Loma plant	Santee plant	San Ysidro plant	Spring Valley plant
Treatment	Lagoon	Trickling filter & lagoon	Primary	Primary	Primary	Aeration & lagoon	Lagoon	Trickling filter
Date Sampled	7-19-62	7-18-62	7-18-62	6-14-62	9-26-63	5-17-62	10-9-62	6-13-62
pH	7.8	8.0	7.3	7.1	6.8	8.4	7.8	7.2
EC x 10^6 at 25° C.	2,160	7,000	1,910	2,792	2,650	1,621	1,890	2,697
Calcium	88	220	94	84	134	64	70	106
Magnesium	41	140	34	50	24	35	44	59
Sodium	305	1,200	205	396	375	202	275	386
Potassium	33	101	28	23	23	20	19	15
Ammonium	18	21	16	65	25	31	--	--
Carbonate	0.0	0.0	0.0	0.0	0.0	36	0.0	0.0
Bicarbonate	318	561	301	458	331	199	217	367
Sulfate	452	396	200	289	331	298	405	420
Chloride	327	2,184	325	534	514	220	280	459
Nitrate	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
Fluoride	0.8	0.6	0.4	1.0	0.8	0.2	0.8	1.9
Boron	0.9	1.2	0.6	1.3	0.8	0.9	0.7	1.3
Silica	33	40	23	20	24	30	29	23
Total dissolved solids	1,436	4,232	1,252	1,950	1,670	1,125	1,266	1,850
Total hardness as $CaCO_3$	391	1,125	378	375	435	223	355	505
Noncarbonate hardness as $CaCO_3$	130	665	131	40	163	84	177	204
Organic Nitrogen as N	81	--	--	--	16	1	--	--
Nitrite as N	0.0	0.0	0.0	--	0.0	0.2	--	--
Orthophosphate	11	21	8	48	29	6	9	--
ABS detergents	10	8	3	--	8	9	19	--
Percent sodium	58	67	49	58	64	51	61	62

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.

TABLE D-6

MINERAL QUALITY OF SEWAGE FROM TRUNK SEWERS
IN THE SAN DIEGO METROPOLITAN SUBAREA

Property*	Balboa	Cabrillo	East San Diego	Encanto	La Jolla	Linda Vista	Mission Valley	Murray Canyon	National City	Rose Canyon
Date sampled	7-17-62 7-18-62	7-17-62 7-18-62	7-18-62 7-19-62	7-18-62 7-19-62	7-19-62 7-20-62	1-31-61	7-16-62 7-17-62	7- 9-58 7-16-58	7-15-58 7-16-58	7-19-62 7-20-62
pH	7.5	7.5	7.3	7.5	7.3	7.4	7.9	6.8	7.4	7.5
EC x 10^6 at 25° C.	1,525	1,530	1,760	2,400	2,500	1,626	1,810	1,563	1,571	1,910
Calcium	73	72	89	96	82	57	46	65	44	109
Magnesium	48	37	41	45	55	35	41	26	24	39
Sodium	172	174	195	346	325	200	250	175	198	210
Potassium	25	24	27	30	45	18	26	22	18	31
Ammonium	5.8	4.5	21	16	37	49	19	49	62	40
Carbonate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	266	260	328	378	314	390	319	328	395	396
Sulfate	362	348	373	375	384	337	336	270	136	379
Chloride	144	145	202	420	459	160	232	150	194	229
Nitrate	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0
Fluoride	1.8	0.7	0.5	0.3	0.8	0.4	1	0.2	0.6	0.1
Boron	0.8	0.8	0.8	0.8	0.6	1.2	0.9	0.6	0.6	1
Silica	30	32	30	29	25	20	33	32	32	22
Total dissolved solids	1,026	1,064	1,300	1,696	1,892	1,060	1,180	1,172	1,056	1,124
Total hardness as $CaCO_3$	382	334	395	423	430	284	283	270	211	433
Noncarbonate hardness as $CaCO_3$	164	120	126	103	172	0.0	21	2	0.0	108
Organic Nitrogen as N	4	3	26	6	3	--	--	--	--	--
Nitrite as N	0.0	0.0	0.0	0.0	0.0	--	0.0	--	--	0.0
Orthophosphate	18	20	12	13	9	--	24	22	46	7
ABS detergents	7	8	11	11	7	--	8	--	--	5
Percent sodium	46	50	46	60	58	49	60	47	52	44

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.

TABLE D-7

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE SAN DIEGO COUNTY SUBAREA

Property*	Alpine	Callan	Cardiff	Carlsbad	Del Mar	Encinitas	Escondido (older plant)	Escondido (newer plant)	Fallbrook	Julian
Treatment	Lagoons	Lagoons	Lagoon	Trickling filter	Lagoons	Trickling filter & lagoon	Trickling filter	Aeration	Lagoons	Lagoons
Date sampled	7-17-62	10-9-62	5-10-62	5-10-62	5-10-62	6-20-62	7-3-63	7-2-63	5-6-63	7-17-62
pH	9.6	7.1	7.6	7.4	8.5	7.3	7.1	7.2	7.8	7.7
EC x 10^6 at 25° C.	1,110	1,460	1,784	2,965	1,819	2,166	1,925	1,950	1,650	485
Calcium	34	98	58	114	68	56	97	71	83	38
Magnesium	27	37	50	83	45	44	41	46	34	9
Sodium	180	160	285	492	331	336	250	275	235	50
Potassium	30	11	21	19	46	23	20	24	14	11
Ammonium	0.0	--	44	3	8	42	--	--	--	3
Carbonate	97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	103	145	377	261	267	370	191	284	311	155
Sulfate	132	362	342	279	380	347	320	323	344	48
Chloride	171	196	272	789	340	288	326	284	182	50
Nitrate	0.0	0.0	0.0	10	1	16	22	4	0.0	0.0
Fluoride	1	0.2	1.1	1.7	0.7	2.5	1.2	1.6	0.8	0.8
Boron	0.8	0.3	0.9	0.5	0.9	1.3	0.7	0.9	0.7	0.3
Silica	43	9	22	16	31	14	27	28	23	25
Total dissolved solids	814	1,008	1,365	2,080	1,390	1,550	1,450	1,292	1,020	328
Total hardness as $CaCO_3$	194	397	348	626	353	303	412	365	347	133
Noncarbonate hardness as $CaCO_3$	0.0	278	39	412	134	19	255	132	92	5
Organic Nitrogen as N	0.5	--	0.4	4	5	2	--	--	--	2
Nitrite as N	0.1	--	0.8	1	0.7	2	--	--	--	0.1
Orthophosphate	0.0	2	35	34	17	56	--	--	--	16
ABS detergents	7	0.5	--	--	--	9	--	--	5	4
Percent sodium	63	46	56	62	62	61	55	60	58	28

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivit in micromhos per cm. at 25° C.

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE SAN DIEGO COUNTY SUBAREA
(continued)

Property*	Oceanside	Pomerado	Ramona	Rancho del Campo	Rancho Santa Fe	San Marcos	Solana Beach	Sorrento	Viejas Honor Camp	Vista
Treatment	Lagoon	Trickling filter	Trickling filter & lagoon	Trickling filter	Aeration	Aeration	Trickling filter & lagoons	Lagoon	Aeration	Trickling filter & lagoons
Date sampled	7-2-63	7-16-62	7-16-62	7-17-62	7-16-62	5-2-62	5-10-62	10-9-62	7-17-62	5-2-62
pH	7.4	8.1	8.9	8.1	8.2	7.0	7.6	7.5	7.7	7.2
EC x 10^6 at 25° C.	2,600	2,040	1,810	1,120	2,000	1,799	2,906	10,200	1,130	1,847
Calcium	106	61	54	42	63	76	58	371	33	96
Magnesium	63	53	45	32	34	55	57	376	34	50
Sodium	370	265	270	137	315	244	492	1,725	150	216
Potassium	23	26	25	16	26	16	23	25	21	13
Ammonium	--	28	4	0.0	2	13	40	--	5	34
Carbonate	0.0	0.0	41	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	460	346	274	289	254	303	342	220	392	426
Sulfate	322	341	218	81	330	308	349	2,323	55	213
Chloride	470	308	298	127	332	256	725	2,613	138	286
Nitrate	0.0	4	8	58	2	1	0.0	0.0	0.0	0.0
Fluoride	1	0.5	1	0.5	1	1.6	0.8	0.8	0.8	1.1
Boron	0.8	0.8	0.8	0.5	0.4	0.1	0.6	1.1	0.2	0.1
Silica	24	30	32	47	10	24	20	11	62	26
Total dissolved solids	1,728	1,254	1,198	758	1,468	1,265	2,070	7,970	746	1,320
Total hardness as $CaCO_3$	523	390	322	237	298	415	532	2,468	222	444
Noncarbonate hardness as $CaCO_3$	147	106	30	0.0	90	167	252	2,288	0.0	95
Organic Nitrogen as N	--	--	--	1	2	0.0	0.0	--	0.3	20
Nitrite as N	--	0.2	0.5	0.4	0.1	0.3	0.5	--	0.0	0.0
Orthophosphate	--	36	9	23	16	58	24	0.0	16	11
ABS detergents	--	6	4	5	0.8	--	--	--	5	--
Percent sodium	59	52	62	54	66	53	61	60	51	46

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.

TABLE D-8

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE CAMP PENDLETON SUBAREA

Property*	Camp Pendleton No. 1	Camp Pendleton No. 2	Camp Pendleton No. 3	Camp Pendleton No. 8**	Camp Pendleton No. 9**	Camp Pendleton No. 10**	Camp Pendleton No. 11**	Camp Pendleton No. 12**	Camp Pendleton No. 13	Fallbrook Naval Reservation
Treatment	Trickling filters & lagoon	Trickling filters & lagoons	Trickling filters & lagoon	Lagoons	Lagoons	Lagoons	Lagoons	Lagoons	Lagoons	Primary
Date sampled	7-5-62	7-5-62	7-5-62	2-25-60	8-59	8-59	8-59	8-59	7-5-62	7-14-60
pH	7.2	7.6	8.2	7.6	8.4	7.4	7.6	10.0	8.1	7.4
EC x 10^6 at 25° C.	1,401	1,240	1,560	1,340	1,865	1,260	1,450	880	1,250	1,530
Calcium	48	65	33	51	65	73	63	38	46	--
Magnesium	35	24	23	24	45	26	32	12	35	--
Sodium	179	158	275	221	200	128	169	120	234	--
Potassium	11	14	26	--	--	--	--	--	21	--
Ammonium	6	3	3	--	--	--	--	--	35	--
Carbonate	0.0	0.0	0.0	--	24	0.0	0.0	43	0.0	--
Bicarbonate	231	232	282	232	376	264	202	15	422	--
Sulfate	134	111	124	120	66	98	90	92	146	--
Chloride	211	196	308	218	322	180	246	160	275	--
Nitrate	41	10	3	3	--	--	--	--	0.0	--
Fluoride	1.7	0.8	0.4	0.4	--	--	--	--	2	0.4
Boron	0.6	0.3	0.6	0.5	0.5	0.6	0.4	0.3	0.6	--
Silica	25	23	43	24	35	32	42	21	32	--
Total dissolved solids	950	746	982	940	1,305	880	1,015	615	1,092	1,070
Total hardness as $CaCO_3$	189	262	175	228	350	290	288	144	260	--
Noncarbonate hardness as $CaCO_3$	74	72	0.0	128	164	182	158	96	0.0	--
Organic Nitrogen as N	0.5	3	8	--	--	--	--	--	43	--
Nitrite as N	0.4	0.3	0.2	--	--	--	--	--	0.5	--
Orthophosphate	33	10	8	--	12	12	15	0.4	24	--
ABS detergents	5	5	6	--	--	--	--	--	7	--
Percent sodium	57	54	73	76	60	488	56	64	55	--

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivit in micromhos per cm. at 25° C.
**Samples taken and analyzed by the Eleventh Naval District.

APPENDIX E

WATER QUALITY CRITERIA

APPENDIX E

WATER QUALITY CRITERIA

For quality standards, water supplies are classified in three general types: domestic, agricultural, and industrial.

Municipal and Domestic Water Quality Criteria

Water used for drinking and cooking should be clear, colorless, odorless, pleasant to the taste, and free from toxic salts. It should not contain excessive amounts of dissolved mineral solids, and it must be free of pathogenic organisms. Probably the most widely used criteria in determining the suitability of a water for this use are the "Public Health Service Drinking Water Standards, 1962", given in Table E-1.

Maximum safe limits of fluoride ion concentrations are related to mean annual temperature and are defined by the California State Department of Public Health as follows:

Mean annual temperature, in °F	Mean monthly maximum fluoride ion concentration, in ppm
50	1.5
60	1.0
70 - above	0.7

Total hardness is a significant factor in the determination of the suitability of water for domestic or municipal use. Waters containing 100 parts per million (ppm) or less of hardness (as $CaCO_3$) are considered "soft", those containing 101 to 200 ppm are considered "moderately hard", and those with more than 200 ppm are considered "very hard".

TABLE E-1

UNITED STATES PUBLIC HEALTH SERVICE
DRINKING WATER STANDARDS

1962

Substance	Recommended limits of concentrations, in mg/l	Mandatory limits of concentrations, in mg/l
Alkyl benzene sulfonate (ABS)	0.5	
Arsenic (As)	0.01	0.05
Barium (Ba)	--	1.0
Cadmium (Cd)	--	0.01
Carbon chloroform extract (CCE)	0.2	--
Chloride (Cl)	250	--
Chromium (Hexavalent) ($Cr+^6$)	--	0.05
Copper (Cu)	1.0	--
Cyanide (CN)	0.01	0.2
Fluoride (F)		
Iron (Fe)	0.3	--
Lead (Pb)	--	0.05
Manganese (Mn)	0.05	--
Nitrate (NO_3)*	45	--
Phenols	0.001	--
Selenium (Se)	--	0.01
Silver (Ag)	--	0.05
Sulfate (SO_4)	250	--
Total dissolved solids (TDS)	500	--
Zinc (Zn)	5	--

*In areas in which the nitrate content of water is known to be in excess of the listed concentration, the public should be warned of the potential dangers of using the water for infant feeding.

Irrigated Agriculture Water Quality Criteria

The major criteria for judging the suitability of water for irrigation are chloride concentration, specific electrical conductance (presented as EC x 10^6 at 25° C), boron concentration, and percent sodium.

Chlorides are present in nearly all waters. They are not necessary to plant growth and, in high concentrations, cause subnormal growing rates and burning of leaves. Relative tolerances of various crop plants to salt are indicated in Table E-2.

TABLE E-2

RELATIVE TOLERANCE OF CROP PLANTS TO SALT[27]

High salt tolerance	Medium salt tolerance	Low salt tolerance
Date palm	Pomegranate	Pear
Salt grass	Fig	Apple
Bermuda grass	Olive	Orange
Rescue grass	Sweet corn	Grapefruit
Western wheatgrass	Potatoes (White Rose)	Prune
Barley	Carrot	Plum
Sugar beet	Onion	Almond
Rape	Sudan grass	Apricot
Cotton	Alfalfa (California common)	Peach
	Rye	Strawberry
	Wheat	Lemon
	Oats	Avocado
	Orchardgrass	Field beans
	Rice	Radish
	Meadow fescue	Celery
	Sorghum (grain)	Meadow foxtail
	Corn (field)	Red clover
	Flax	
	Sunflower	
	Castor beans	

Electrical conductance indicates the total dissolved solids and furnishes an approximate indication of the overall mineral quality of the water. For most waters, the total dissolved solids, measured in parts per million, may be approximated by multiplying the specific electrical conductance by 0.7. As the amount of dissolved salts in irrigation water increases, the crop yields are reduced until, at high concentrations (the value depending on the plant, type of soil, climatological conditions, and amount of water applied), plants cannot survive.

Boron is never found in the free state but occurs in the form of borates or boric acid. This element is essential in minor amounts for the growth of many but not all plants. It is, however, extremely toxic to most plants in higher concentrations. Limits of tolerance for most irrigated crops vary from 0.5 to 2.0 ppm. Citrus crops, particularly lemons, are sensitive to boron in concentrations exceeding 0.5 ppm. Relative tolerances of various crop plants to boron are listed in Table E-3, and permissible limits of boron for several classes of irrigation water are shown in Table E-4.

TABLE E-3

RELATIVE TOLERANCE OF CROP PLANTS TO BORON[26]

(In each group the plants first named are considered as being more sensitive and the last named more tolerant)

Sensitive to boron	Semitolerant to boron	Tolerant to boron
Lemon	Lima bean	Carrot
Grapefruit	Sweet potato	Lettuce
Avocado	Bell pepper	Cabbage
Orange	Tomato	Turnip
Thornless blackberry	Pumpkin	Onion
Apricot	Zinnia	Broad bean
Peach	Oat	Gladiolus
Cherry	Milo	Alfalfa
Persimmon	Corn	Garden beet
Kadota fig	Wheat	Mangel
Grape (Sultanina and Malaga)	Barley	Sugar beet
Apple	Olive	Palm (Phoenix carariensis)
Pear	Ragged robin rose	
Plum	Field pea	Date palm (P. dactylifera)
American elm	Radish	
Navy bean	Sweet pea	Asparagus
Jerusalem-artichoke	Pima cotton	Athel (Tamarix aphylla)
Persian (English) walnut	Acala cotton	
Black walnut	Potato	
Pecan	Sunflower (native)	

The percent sodium, as reported in analyses, is 100 times the proportion of the sodium cation to the sum of all cations, all expressed in equivalents per million. Water containing a high percent sodium has

TABLE E-4

PERMISSIBLE LIMITS OF BORON FOR SEVERAL CLASSES OF[26] IRRIGATION WATER

In parts per million

Classes of water	Crop groups		
	Sensitive	Semitolerant	Tolerant
Excellent	Less than 0.33	Less than 0.67	Less than 1.00
Good	0.33 to 0.67	0.67 to 1.33	1.00 to 2.00
Permissible	0.67 to 1.00	1.33 to 2.00	2.00 to 3.00
Doubtful	1.00 to 1.25	2.00 to 2.50	3.00 to 3.75
Unsuitable	Greater than 1.25	Greater than 2.50	Greater than 3.75

an adverse effect on the physical structure of soils that contain clay. This is because it disperses the soil colloids, and these, in turn, retard the movement of water and the leaching of salts, and make the soils difficult to work. The effect of potassium in water is similar to that of sodium.

Because of the diverse climatological conditions, crops, soils, and irrigation practices in California, criteria that may be set up to establish the suitability of water for irrigation must be general, and judgment must be used in applying these criteria to individual cases.

Based on results of studies by Dr. L. D. Doneen, Professor of Irrigation at the University of California at Davis, three general classes of irrigation water have been established:

Class 1 Excellent to good. Regarded as safe and suitable for most plants under any condition of soil or climate.

Class 2 Good to injurious. Regarded as possibly harmful for certain crops under certain conditions of soil or climate, particularly in the higher ranges of this class.

Class 3 Injurious to unsatisfactory. Regarded as probably harmful to most crops and unsatisfactory for all but the most tolerant.

Limiting values for concentrations of total dissolved solids, chloride, boron, electrical conductance, and percent sodium for these three classes of irrigation water are shown in Table E-5.

TABLE E-5

UNIVERSITY OF CALIFORNIA CRITERIA FOR IRRIGATION WATERS

Factors	Class 1 Excellent to good	Class 2 Good to injurious	Class 3 Injurious to unsatisfactory
Electrical conductance, EC x 10^6 at 25° C	Less than 1,000	1,000 - 3,000	More than 3,000
Boron, ppm	Less than 0.5	0.5 - 2.0	More than 2.0
Chloride, ppm	Less than 175	175 - 350	More than 350
Percent sodium	Less than 60	60 - 75	More than 75

Industrial Water Quality Criteria

A standard of quality of water for industrial purposes is exceedingly difficult to ascertain. Industrial usage of water is so varied that a single set of standards for chemical, physical, and bacterial requirements would be meaningless. Table E-6 shows approximate water quality requirements for individual industries; the quality limits should be considered flexible. Even criteria obtained for the industries mentioned are not conclusive for all constituents. Water for industrial purposes must, therefore, be considered as a raw material to be treated, if necessary, by the industrial user to fit individual needs and requirements.

TABLE E-6

LIMITS OF MINERAL CONCENTRATIONS, PHYSICAL PROPERTIES, AND BACTERIAL QUALITY OF WATER FOR VARIOUS INDUSTRIAL USES

Allowable limits, in parts per million except as noted

Constituent or property	Boiler feed water[a], boiler pressure in pounds per square inch			Concrete mixing[ae]	Cooling water	Production of plastics[a]	Steel manufacturing[a]	Tanning operations[a]	Textile manufacturing[a]	Production of paper[a]	
	0-150	150-250	250-400							Groundwood[g]	Soda and sulfate pulp[h]
Total solids	3,000-500[b]	2,500-500[b]	1,500-100[b]	--	--	200	--	--	--	--	--
pH value	8.0 minimum	8.4 minimum	9.0 minimum	high values desired	7 to 9[f]	--	6.8 to 7.0	6.0 to 8.0	--	--	--
Chlorides (Cl)	--	--	--	--		--	175	--	100	75	75
Iron (Fe)	--	--	--	--	0.5[a]	0.02	--	0.1 to 2.0	0.1 to 1.0	0.3	0.1
Manganese (Mn)	--	--	--	--	0.5[a]	0.02	--	0.1 to 0.2	0.05 to 1.0	0.1	0.05
Iron and Manganese (Fe + Mn)	--	--	--	--	0.5[a]	0.02	--	0.2	0.2 to 1.0	--	--
Suspended matter	--	--	--	--	--	--	25	--	--	--	--
Temperature, ° F.	--	--	--	--	--	--	75° F.	--	--	--	--
Turbidity	20	10	5	--	50[a]	2	--	20	0.3 to 25	--	--
Color	80	40	5	--	--	2	--	10 to 100	5 to 70	30[j]	.5[j]
Dissolved oxygen	1.4[c]	0.14[c]	0.0[c]	--	--	--	--	--	--	--	--
Hydrogen sulfide (H_2S)	5[d]	3[d]	0[d]	--	--	--	--	--	--	--	--
Total hardness ($CaCO_3$)	80	40	10	--	50[a]	--	50	50 to 513	50	200	100
Sulfate-carbonate ratio (ASME) ($Na_2SO_4 : Na_2CO_3$)	1:1	2:1	3:1	--	--	--	--	--	--	--	--
Aluminum oxide (Al_2O_3)	5	0.5	0.05	--	--	--	--	--	--	--	--
Silica (SiO_2)	40	20	5	--	--	--	--	--	--	--	--
Bicarbonate (HCO_3)	50[c]	30[c]	5[c]	--	--	--	--	--	200	--	--
Carbonate (CO_3)	200	100	40	--	--	--	--	--	--	--	--
Hydroxide (OH)	50	40	30	--	--	--	--	--	--	--	--
Oxygen consumed	15	10	4	--	--	--	--	--	8	--	--
Total dissolved solids	--	--	--	100 minimum	2,500[f]	--	--	--	--	500	250
Free carbon dioxide (CO_2)	--	--	--	20	--	--	--	--	--	10	10
Sulfide (SO_3)	--	--	--	25	--	--	--	--	--	--	--
5 day BOD	--	--	--	--	--	--	25	--	--	--	--
Corrosion potential	--	--	--	--	--	--	Low as possible	--	--	--	--
Alkalinity	--	--	--	--	--	---		128 to 135	--	150	75
Heavy metals	--	--	--	--	--	--	--	--	None	--	--
Calcium (Ca)	--	--	--	--	--	--	--	--	10	--	--
Magnesium (Mg)	--	--	--	--	--	--	--	--	5	--	--
Sulfate (SO_4)	--	--	--	--	--	--	--	--	100	--	--

LIMITS OF MINERAL CONCENTRATIONS, PHYSICAL PROPERTIES,
AND BACTERIAL QUALITY OF WATER FOR VARIOUS INDUSTRIAL USES
(continued)

Allowable limits, in parts per million except as noted

Constituent or property	Boiler feed water[a], boiler pressure in pounds per square inch			Concrete mixing[ae]	Cooling water	Production of plastics[a]	Steel manufacturing[a]	Tanning operations[a]	Textile manufacturing	Production of paper[a]	
	0-150	150-250	250-400							Groundwood[g]	Soda and sulfate pulp[h]
Turbidity as SiO_2	--	--	--	--	--	--	--	--	--	50[k]	25[k]
Silica (Soluble as SiO_2)	--	--	--	--	--	--	--	--	--	50	20
Calcium hardness as $CaCO_3$	--	--	--	--	--	--	--	--	--	--	50
Magnesium hardness as $CaCO_3$	--	--	--	--	--	--	--	--	--	--	50

a. California State Water Pollution Control Board, "Water Quality Criteria", Publication No. 3, 1952.
b. Depends on design of boiler.
c. Limits applicable only to feed water entering boiler, not to original supply.
d. Except where odor in live steam would be objectionable.
e. Water considered good enough to drink is considered safe for concrete unless otherwise noted.
f. California State Water Pollution Control Board, "A Survey of Direct Utilization of Waste Waters", Publication No. 12, 1955.
g. Groundwood papers are coarse papers composed primarily of groundwood fibers such as used for newspapers, telephone directories, cheapar grades of catalogues, and pulp magazines.
h. Pulps produced by chemical cooking processes known as the soda process and the sulfate or kraft process are also called alkaline pulps.
j. Color in platinum units.
k. Materials causing turbidity shall not be gritty.

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

LOCATION MAP

SCALE OF MILES
4 0 4 8 12

1965


LOCATION OF
SAN DIEGO REGION
OREGON
NEVADA
ARIZONA
MEXICO
PACIFIC OCEAN
SAN FRANCISCO
SACRAMENTO
LOS ANGELES
LEGEND
BOUNDARY OF AREA OF INVESTIGATION
SAN DIEGO METROPOLITAN AND CAMP PENDLETON SUBAREAS
PENINSULA RANGE
SAN DIEGO COUNTY SUBAREA
CAMP PENDLETON SUBAREA
SAN DIEGO METROPOLITAN SUBAREA
RIVERSIDE CO
SAN DIEGO CO
ORANGE CO
RIVERSIDE CO
CALIFORNIA
MEXICO
PACIFIC
OCEAN
LAGUNA BEACH
SAN CLEMENTE
SAN JUAN CAPISTRANO
OCEANSIDE
CARLSBAD
LEUCADIA
ENCINITAS
CARDIFF
SOLANA BEACH
DEL MAR
LA JOLLA
MISSION BAY
SAN DIEGO
CORONADO
PT LOMA
NATIONAL CITY
CHULA VISTA
IMPERIAL BEACH
ESCONDIDO
SAN MARCOS
VISTA
FALLBROOK
TEMECULA
RAMONA
JULIAN
ALPINE
LAKESIDE
SANTEE
EL CAJON
LA MESA
SPRING VALLEY
POWAY
CAMPO
RANCHO SANTA FE
LAKE HENSHAW
VAIL RESERVOIR
SUTHERLAND RESERVOIR
LAKE WOHLFORD
LAKE HODGES
CUYAMACA RESERVOIR
EL CAPITAN RESERVOIR
SAN VICENTE RESERVOIR
CHET HARRITT RESERVOIR
MIRAMAR RESERVOIR
MURRAY RESERVOIR
SWEETWATER RESERVOIR
UPPER OTAY RESERVOIR
LOWER OTAY RESERVOIR
LAKE LOVELAND
BARRETT LAKE
MORENA LAKE
SAN LUIS REY RIVER
SANTA MARGARITA RIVER
SAN DIEGUITO RIVER
SAN DIEGO RIVER
SWEETWATER RIVER
OTAY RIVER
TIA JUANA R
SAN YSIDRO
FIRST
SECOND
SAN DIEGO AQUEDUCT
FALLBROOK OCEANSIDE BRANCH
Tucalota Creek
Murrieta Creek
San Juan Creek
Aliso Creek
San Marcos Creek
Escondido Creek
Santa Ysabel Creek
Santa Maria Cr
Boulder Creek
Cottonwood Creek
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
LOCATION MAP
SCALE OF MILES
4 0 4 8 12
1965

PLATE 2

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

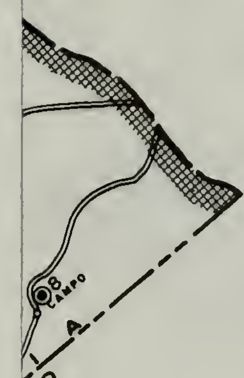
MAJOR WATER SUPPLY FACILITIES AND LOCATION OF SAMPLING WELLS

SCALE OF MILES

4 0 4 8 12

1965

LOCATION OF
SAN DIEGO REGION



LEGEND

◉ WELL YIELDING WATER REPRESENTATIVE IN QUALITY OF THE OVERALL GROUND WATER SUPPLY IN COASTAL SAN DIEGO COUNTY

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

MAJOR WATER SUPPLY FACILITIES
AND LOCATION OF SAMPLING WELLS

SCALE OF MILES

4 0 4 8 12

1965

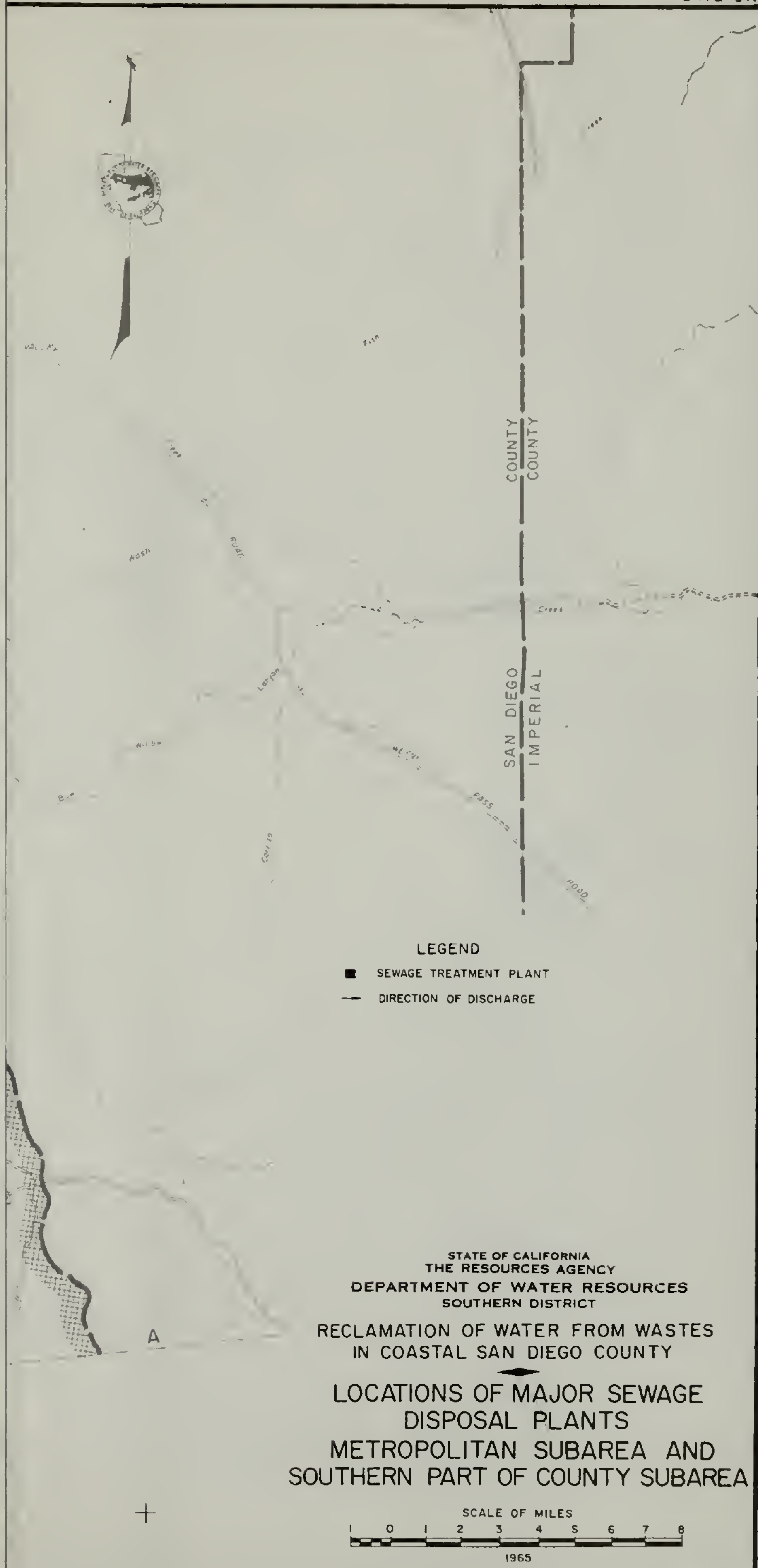
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

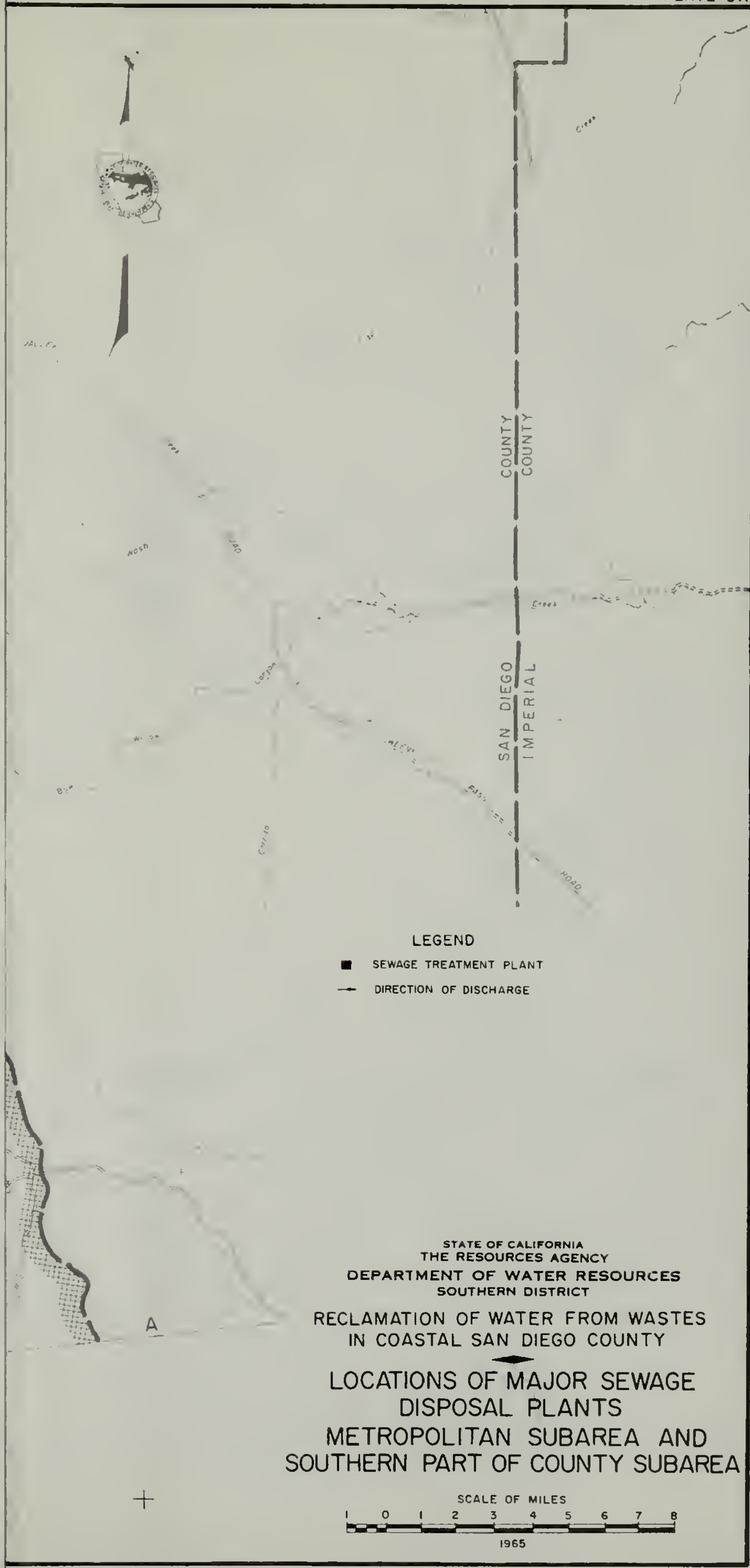
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

MAJOR WATER SUPPLY FACILITIES
AND LOCATION OF SAMPLING WELLS

1965

PLATE 3A

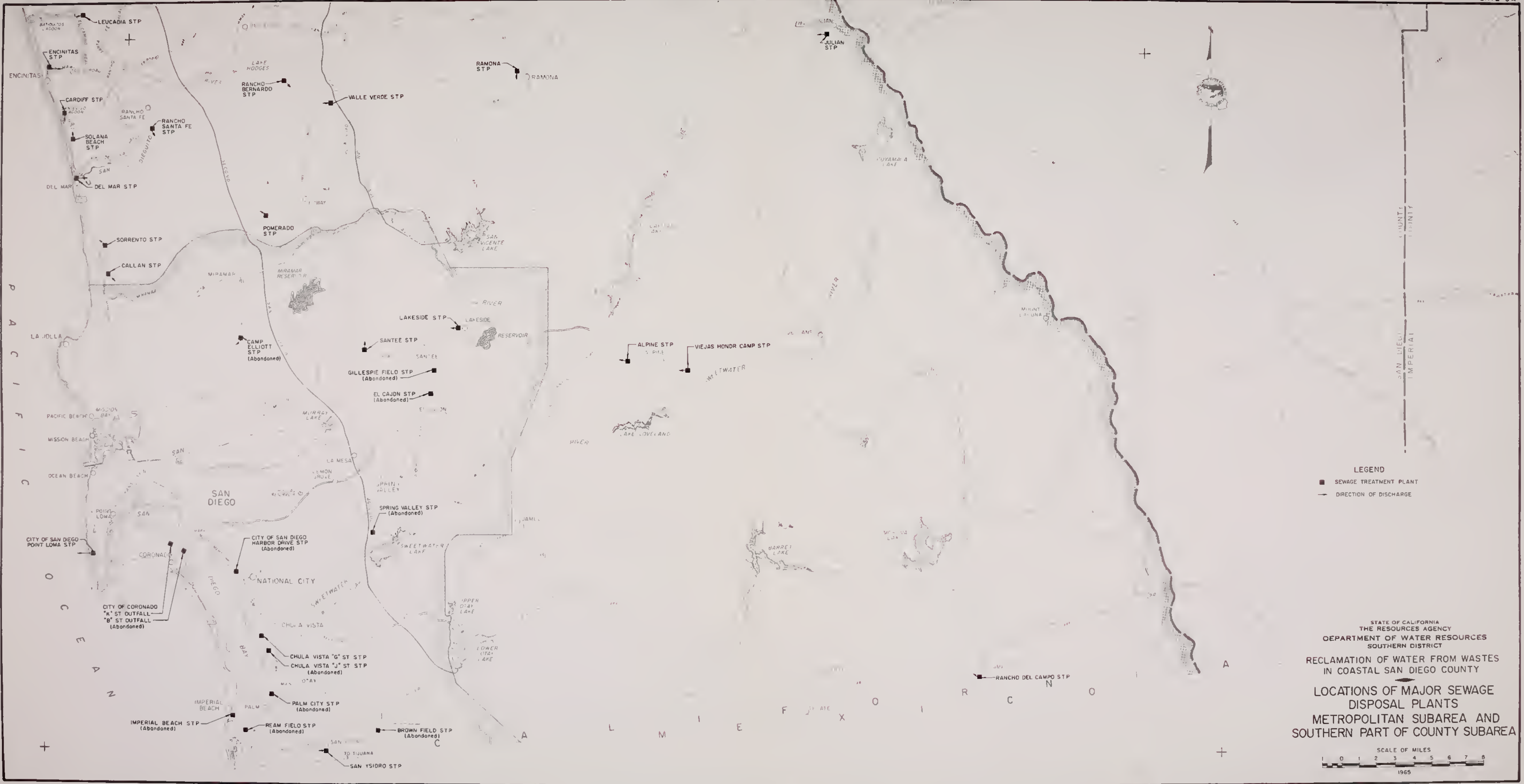

SAN DIEGO COUNTY
IMPERIAL COUNTY
LEGEND
SEWAGE TREATMENT PLANT
DIRECTION OF DISCHARGE
A
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
LOCATIONS OF MAJOR SEWAGE
DISPOSAL PLANTS
METROPOLITAN SUBAREA AND
SOUTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1965



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES IN COASTAL SAN DIEGO COUNTY

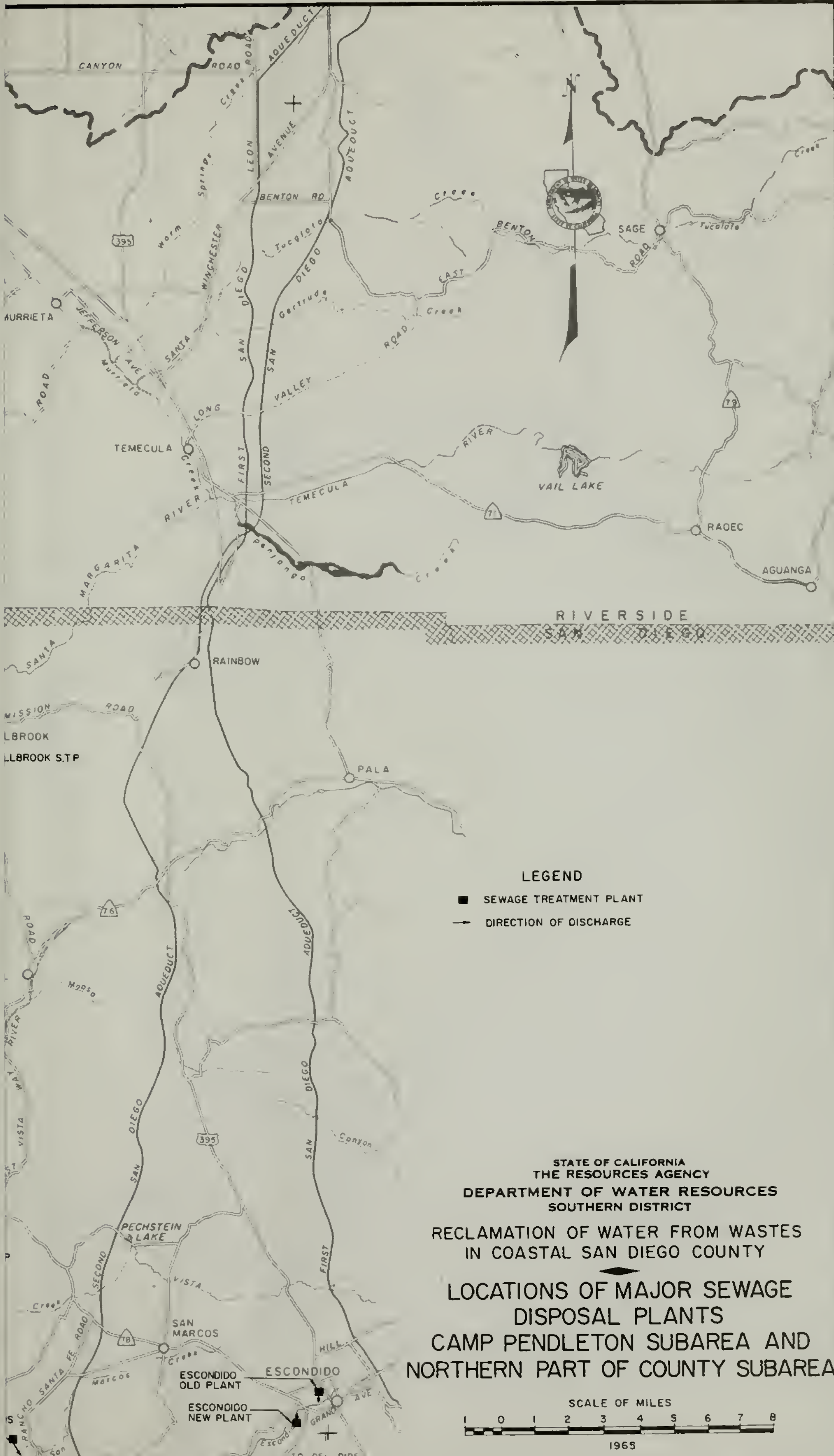
LOCATIONS OF MAJOR SEWAGE DISPOSAL PLANTS METROPOLITAN SUBAREA AND SOUTHERN PART OF COUNTY SUBAREA



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES IN COASTAL SAN DIEGO COUNTY

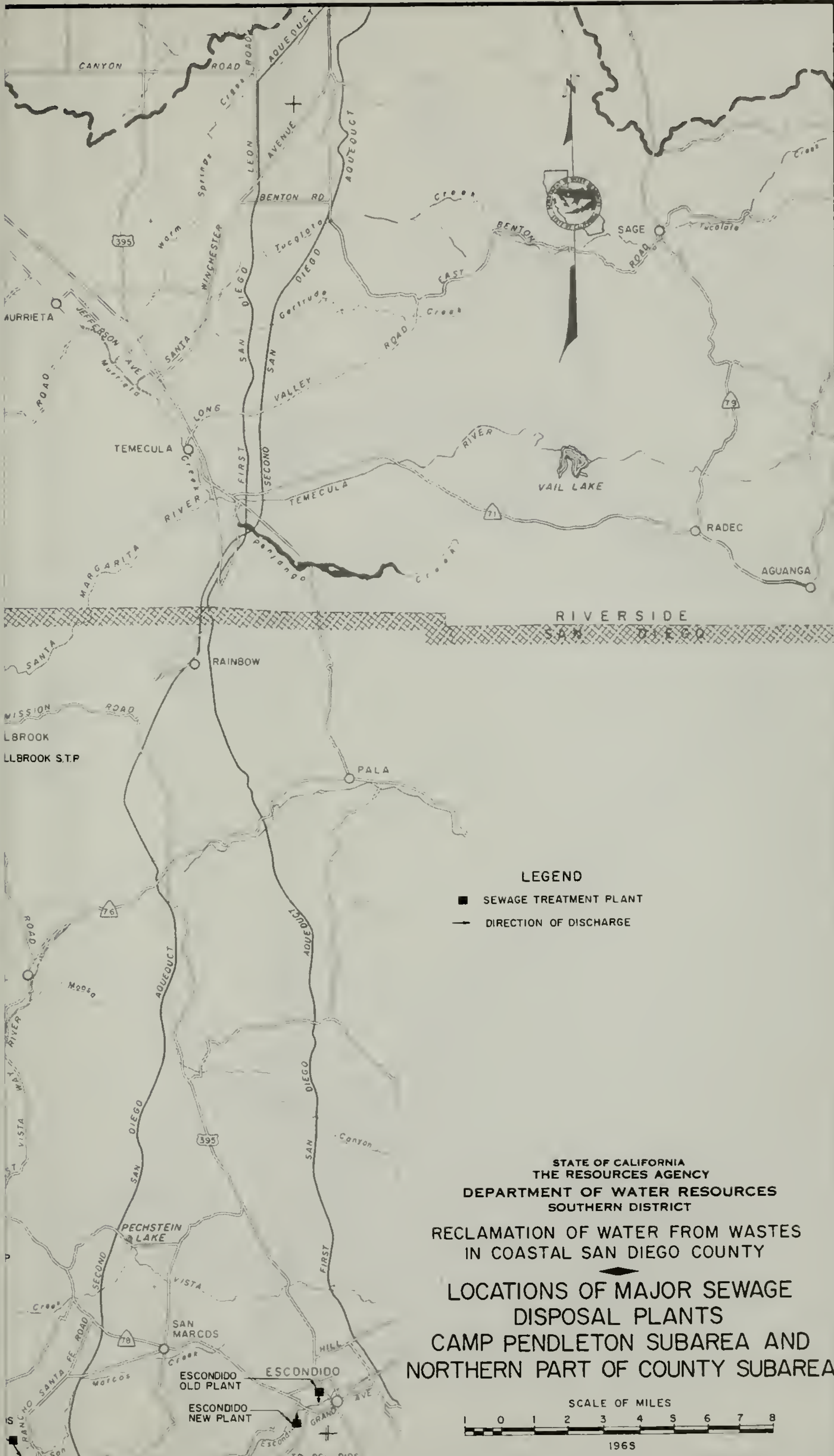
LOCATIONS OF MAJOR SEWAGE DISPOSAL PLANTS METROPOLITAN SUBAREA AND SOUTHERN PART OF COUNTY SUBAREA



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

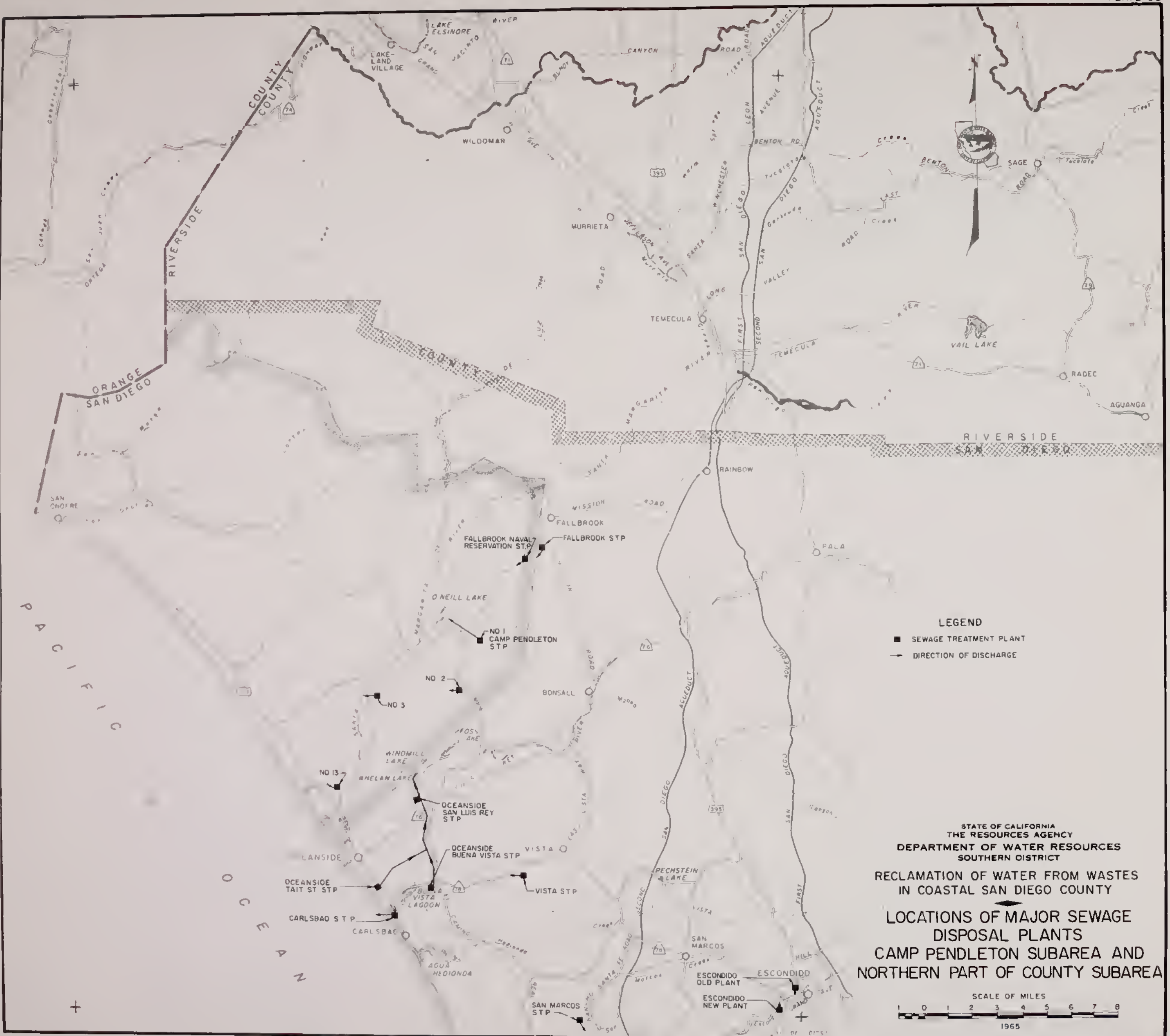
LOCATIONS OF MAJOR SEWAGE DISPOSAL PLANTS CAMP PENDLETON SUBAREA AND NORTHERN PART OF COUNTY SUBAREA

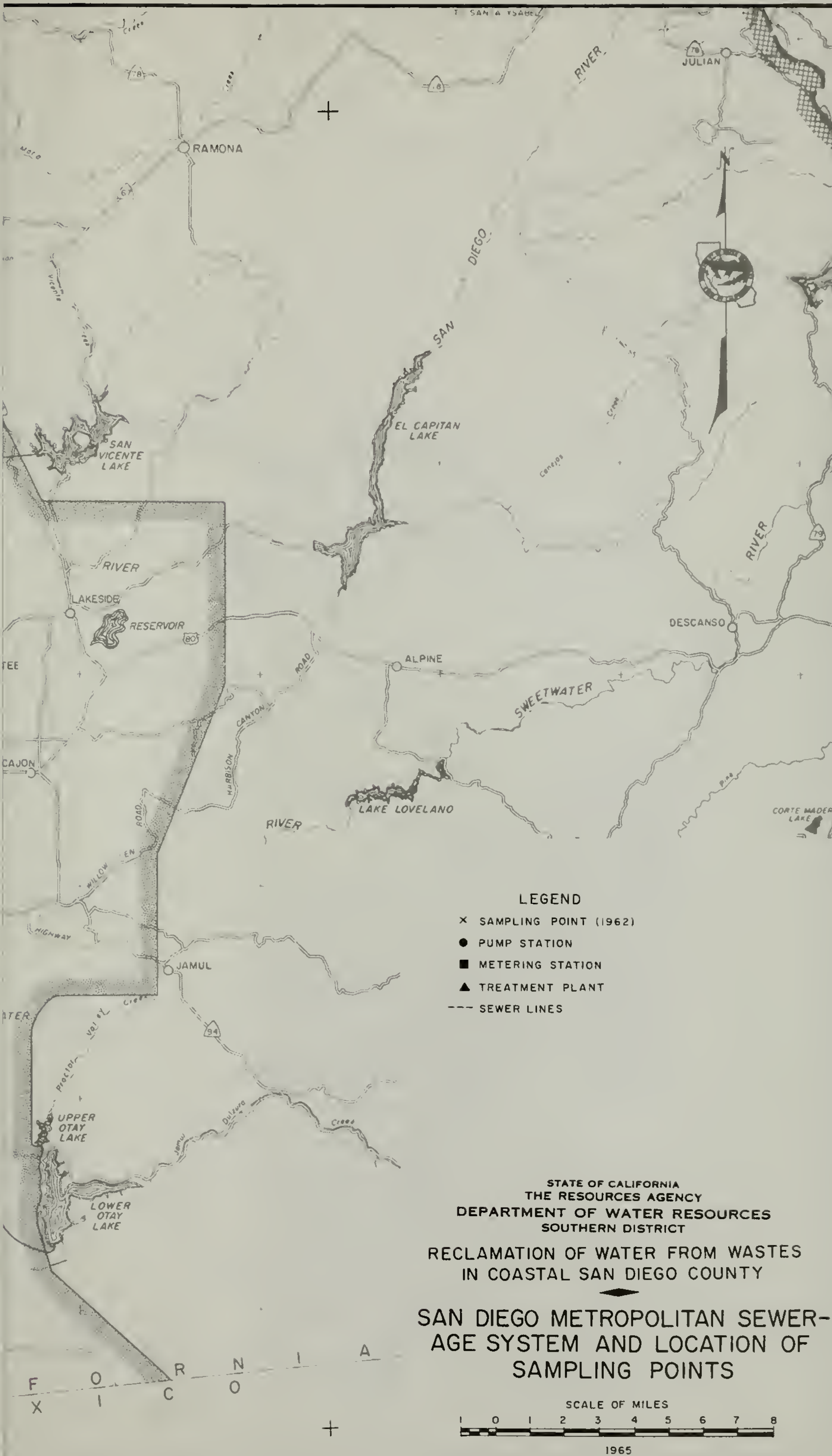


STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES IN COASTAL SAN DIEGO COUNTY

LOCATIONS OF MAJOR SEWAGE DISPOSAL PLANTS
CAMP PENDLETON SUBAREA AND NORTHERN PART OF COUNTY SUBAREA


LEGEND
SEWAGE TREATMENT PLANT
DIRECTION OF DISCHARGE
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
LOCATIONS OF MAJOR SEWAGE
DISPOSAL PLANTS
CAMP PENDLETON SUBAREA AND
NORTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1965
PACIFIC OCEAN
ORANGE
SAN DIEGO
RIVERSIDE
COUNTY
RIVERSIDE
SAN DIEGO
LAKE ELSINORE
LAKE-LAND VILLAGE
WILDOMAR
MURRIETA
TEMECULA
SAGE
VAIL LAKE
RADEC
AGUANGA
RAINBOW
FALLBROOK
FALLBROOK NAVAL RESERVATION STP
FALLBROOK STP
PALA
O NEILL LAKE
NO 1 CAMP PENDLETON STP
NO 2
NO 3
NO 13
BONSALL
WINDMILL LAKE
WHELAN LAKE
OCEANSIDE SAN LUIS REY STP
OCEANSIDE BUENA VISTA STP
OCEANSIDE TAIT ST STP
VISTA
VISTA STP
CARLSBAD STP
CARLSBAD
BUENA VISTA LAGOON
AGUA HEDIONDA
SAN MARCOS
SAN MARCOS STP
ESCONDIDO
ESCONDIDO OLD PLANT
ESCONDIDO NEW PLANT
PECHSTEIN LAKE
SAN ONOFRE
BENTON RD
FIRST SAN DIEGO AQUEDUCT
SECOND SAN DIEGO AQUEDUCT



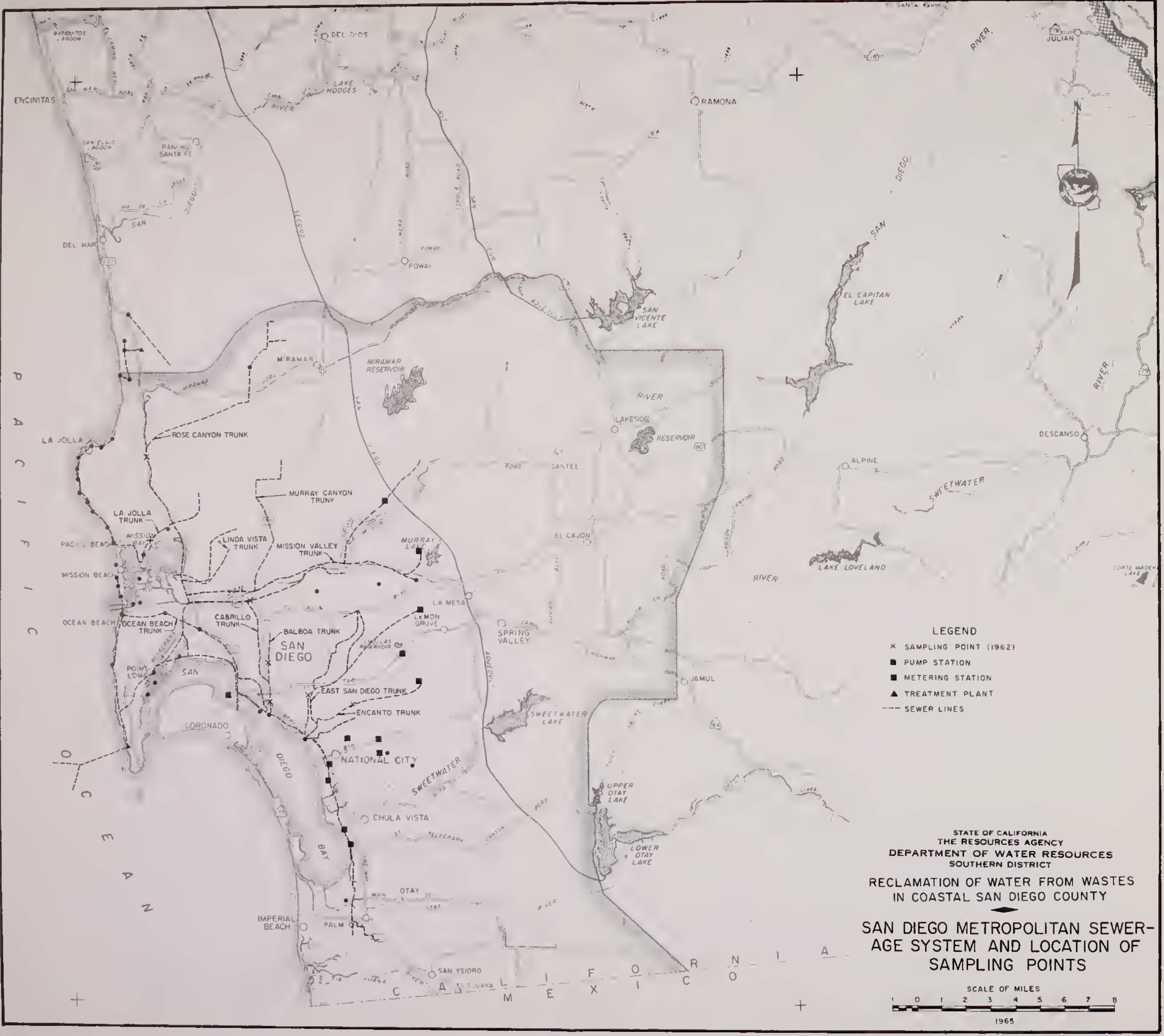
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

SAN DIEGO METROPOLITAN SEWERAGE SYSTEM AND LOCATION OF SAMPLING POINTS

1965

RAMONA
JULIAN
SAN DIEGO RIVER
SAN VICENTE LAKE
EL CAPITAN LAKE
RIVER
LAKESIDE
RESERVOIR
DESCANSO
ALPINE
SWEETWATER
RIVER
CANYON ROAD
HARBISON
LAKE LOVELAND
CORTE MADERA LAKE
WILLOW GLEN ROAD
HIGHWAY
JAMUL
UPPER OTAY LAKE
LOWER OTAY LAKE
CAJON
F O R N I A
X I C O
LEGEND
× SAMPLING POINT (1962)
● PUMP STATION
■ METERING STATION
▲ TREATMENT PLANT
--- SEWER LINES
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
SAN DIEGO METROPOLITAN SEWERAGE SYSTEM AND LOCATION OF SAMPLING POINTS
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1965



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES IN COASTAL SAN DIEGO COUNTY

SAN DIEGO METROPOLITAN SEWERAGE SYSTEM AND LOCATION OF SAMPLING POINTS

LEGEND

FLOW FOR MINIMUM DAY IN EACH MONTH.

AVERAGE DAILY FLOW FOR EACH MONTH (BASED ON TOTAL MONTHLY FLOW)

FLOW FOR MAXIMUM DAY IN EACH MONTH

S.T.P. SEWAGE TREATMENT PLANT

VARIATION OF MONTHLY DISCHARGES
OF SEWAGE FROM THE
SAN DIEGO METROPOLITAN SUBAREA
DURING 1961-62

LEGEND

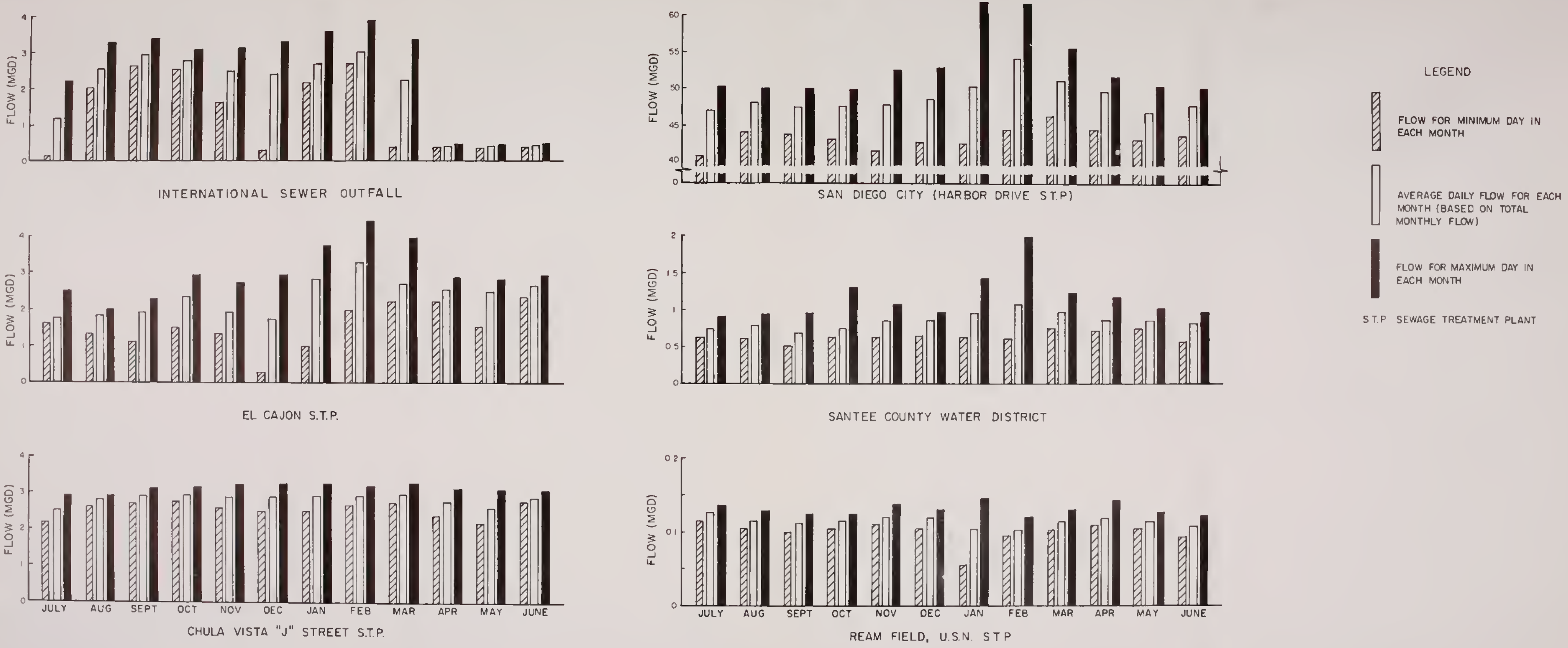
FLOW FOR MINIMUM DAY IN EACH MONTH.

AVERAGE DAILY FLOW FOR EACH MONTH (BASED ON TOTAL MONTHLY FLOW)

FLOW FOR MAXIMUM DAY IN EACH MONTH

S.T.P. SEWAGE TREATMENT PLANT

VARIATION OF MONTHLY DISCHARGES
OF SEWAGE FROM THE
SAN DIEGO METROPOLITAN SUBAREA
DURING 1961-62



VARIATION OF MONTHLY DISCHARGES OF SEWAGE FROM THE SAN DIEGO METROPOLITAN SUBAREA DURING 1961-62

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1965

LEGEND

FLOW FOR MINIMUM DAY IN EACH MONTH.

AVERAGE DAILY FLOW FOR EACH MONTH (3ASED ON TOTAL MONTHLY FLOW)

FLOW FOR MAXIMUM DAY IN EACH MONTH

S.T.P. SEWAGE TREATMENT PLANT

VARIATION OF MONTHLY DISCHARGES
OF SEWAGE FROM THE
SAN DIEGO COUNTY SUBAREA
DURING 1961-62

LEGEND

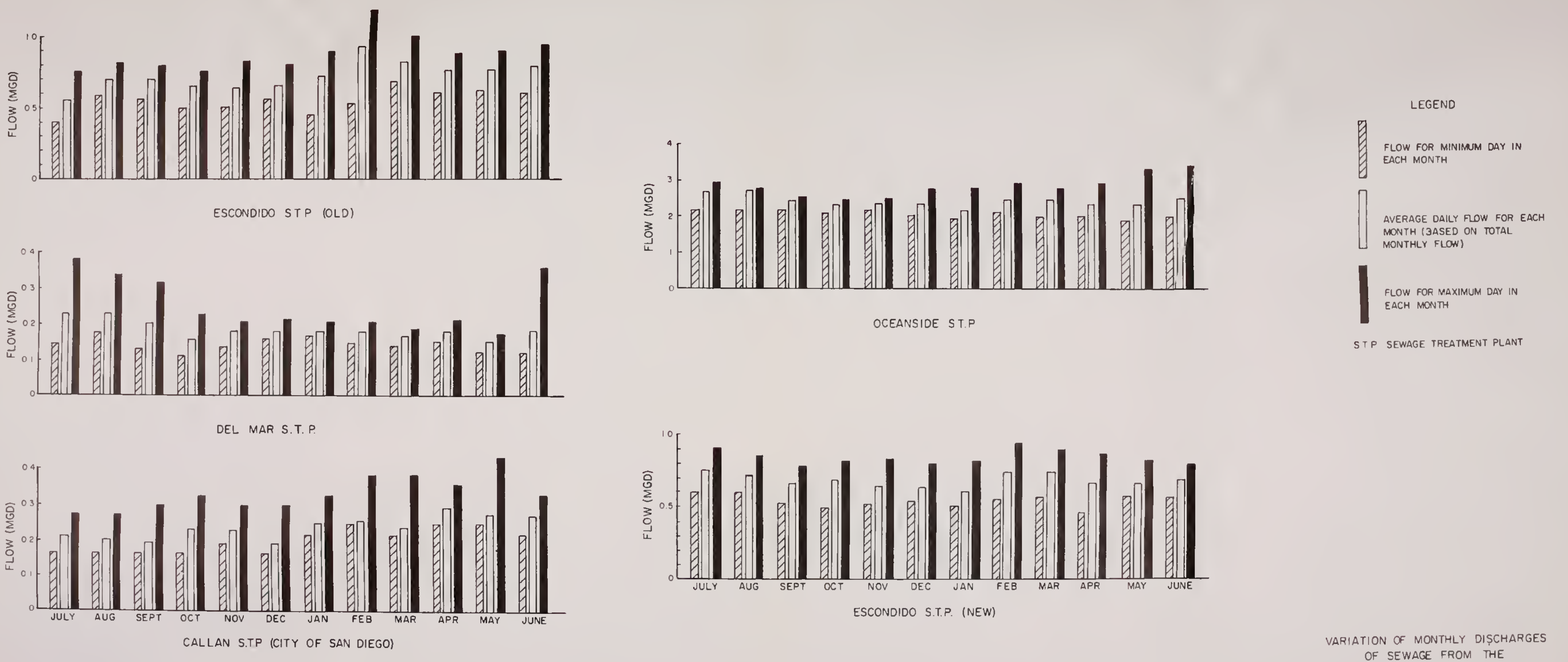
FLOW FOR MINIMUM DAY IN EACH MONTH.

AVERAGE DAILY FLOW FOR EACH MONTH (3ASED ON TOTAL MONTHLY FLOW)

FLOW FOR MAXIMUM DAY IN EACH MONTH

S.T.P. SEWAGE TREATMENT PLANT

VARIATION OF MONTHLY DISCHARGES
OF SEWAGE FROM THE
SAN DIEGO COUNTY SUBAREA
DURING 1961-62



VARIATION OF MONTHLY DISCHARGES OF SEWAGE FROM THE SAN DIEGO COUNTY SUBAREA DURING 1961-62

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1966

LEGEND

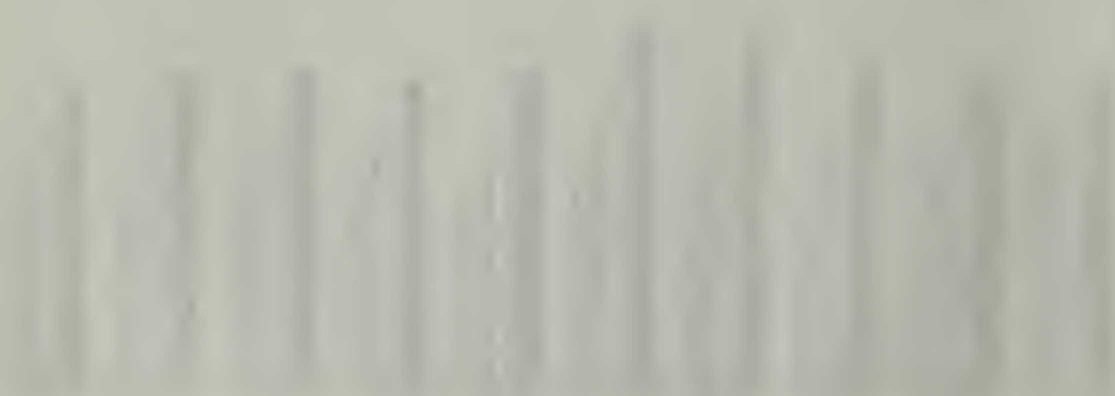
FLOW FOR MINIMUM DAY IN EACH MONTH.

AVERAGE DAILY FLOW FOR EACH MONTH (BASED ON TOTAL MONTHLY FLOW)

FLOW FOR MAXIMUM DAY IN EACH MONTH

S.T.P. SEWAGE TREATMENT PLANT

VARIATION OF MONTHLY DISCHARGES
OF SEWAGE FROM THE
CAMP PENDLETON SUBAREA
DURING 1961-62



LEGEND

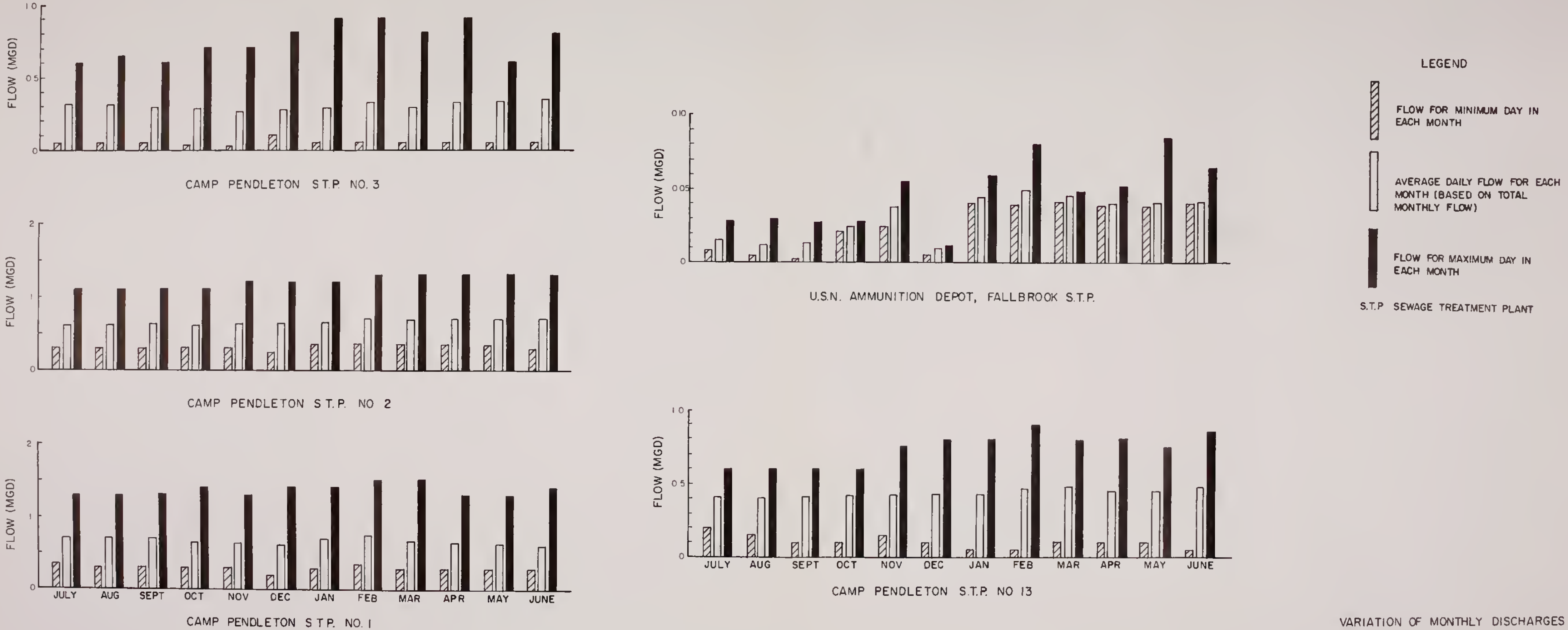
FLOW FOR MINIMUM DAY IN EACH MONTH.

AVERAGE DAILY FLOW FOR EACH MONTH (BASED ON TOTAL MONTHLY FLOW)

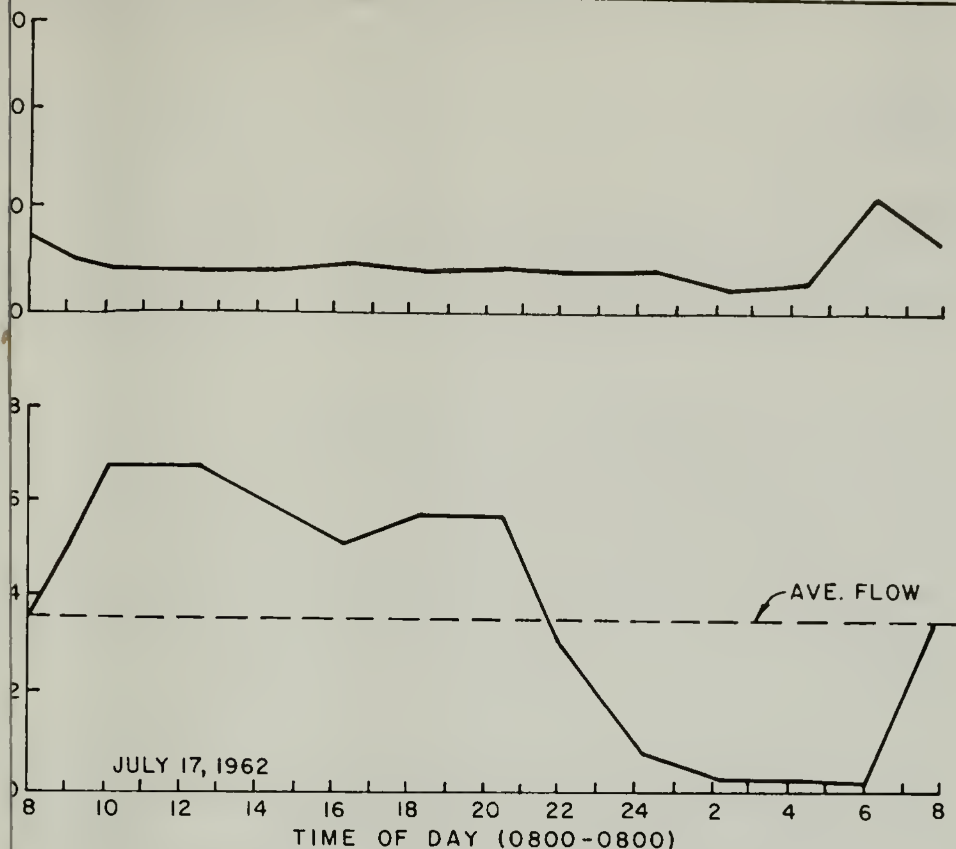
FLOW FOR MAXIMUM DAY IN EACH MONTH

S.T.P. SEWAGE TREATMENT PLANT

VARIATION OF MONTHLY DISCHARGES
OF SEWAGE FROM THE
CAMP PENDLETON SUBAREA
DURING 1961-62

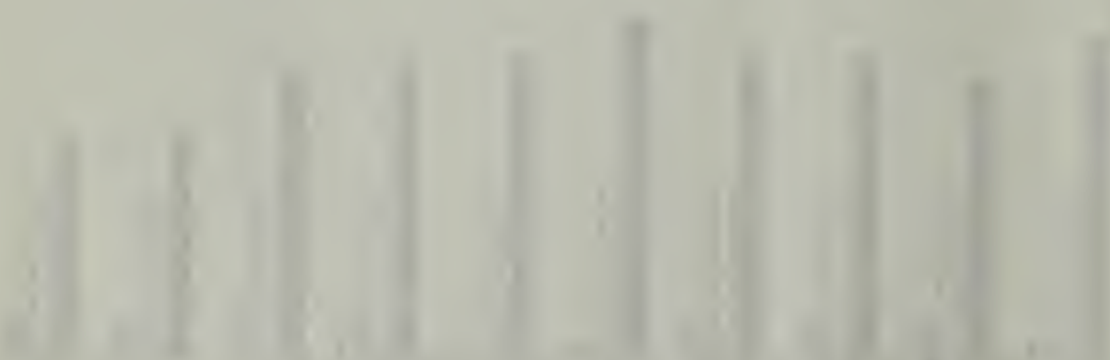


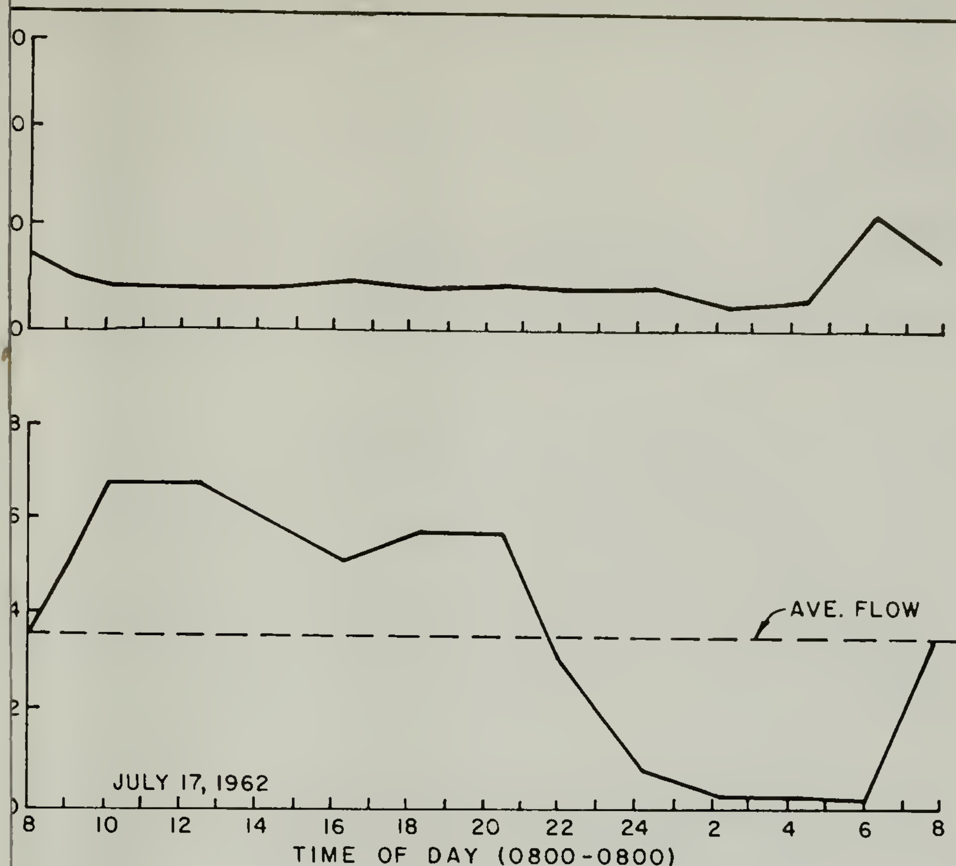
VARIATION OF MONTHLY DISCHARGES
OF SEWAGE FROM THE
CAMP PENOLETON SUBAREA
DURING 1961-62



CABRILLO TRUNK SEWER

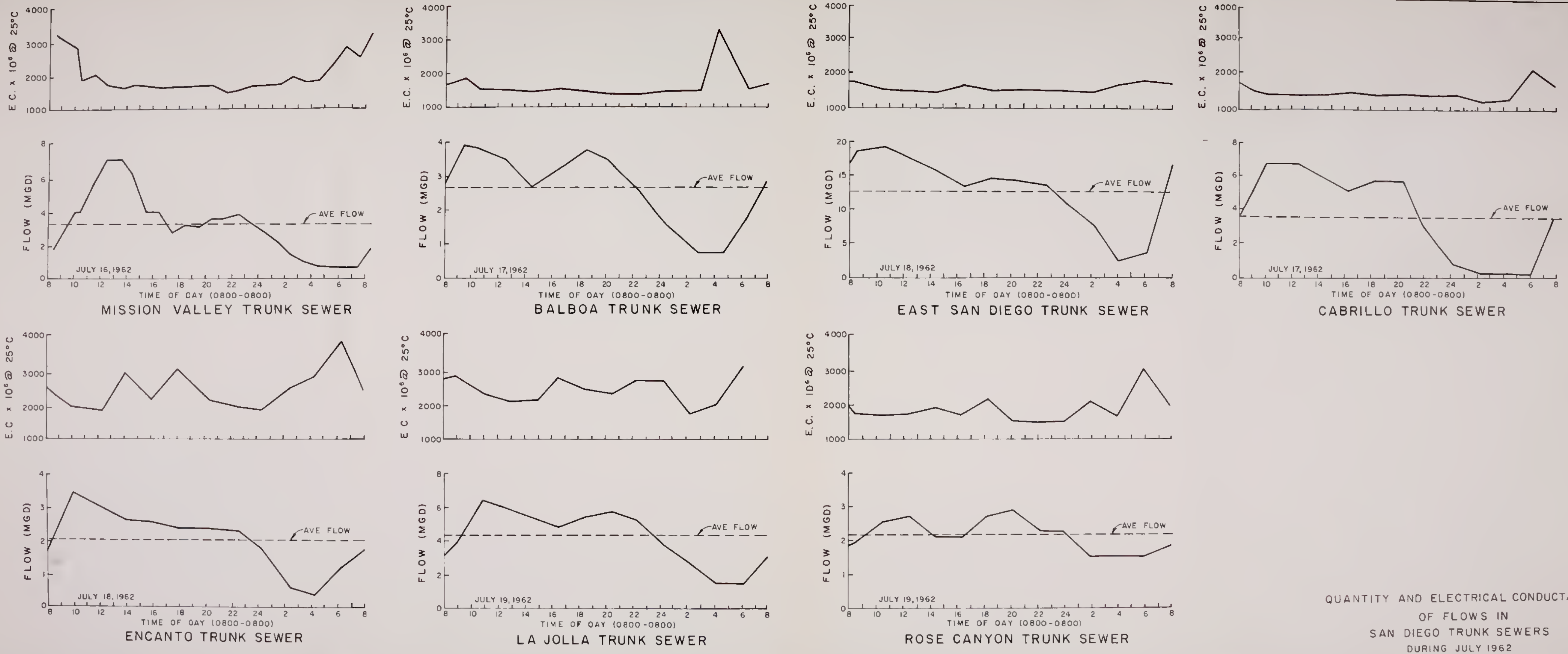
QUANTITY AND ELECTRICAL CONDUCTANCE
OF FLOWS IN
SAN DIEGO TRUNK SEWERS
DURING JULY 1962





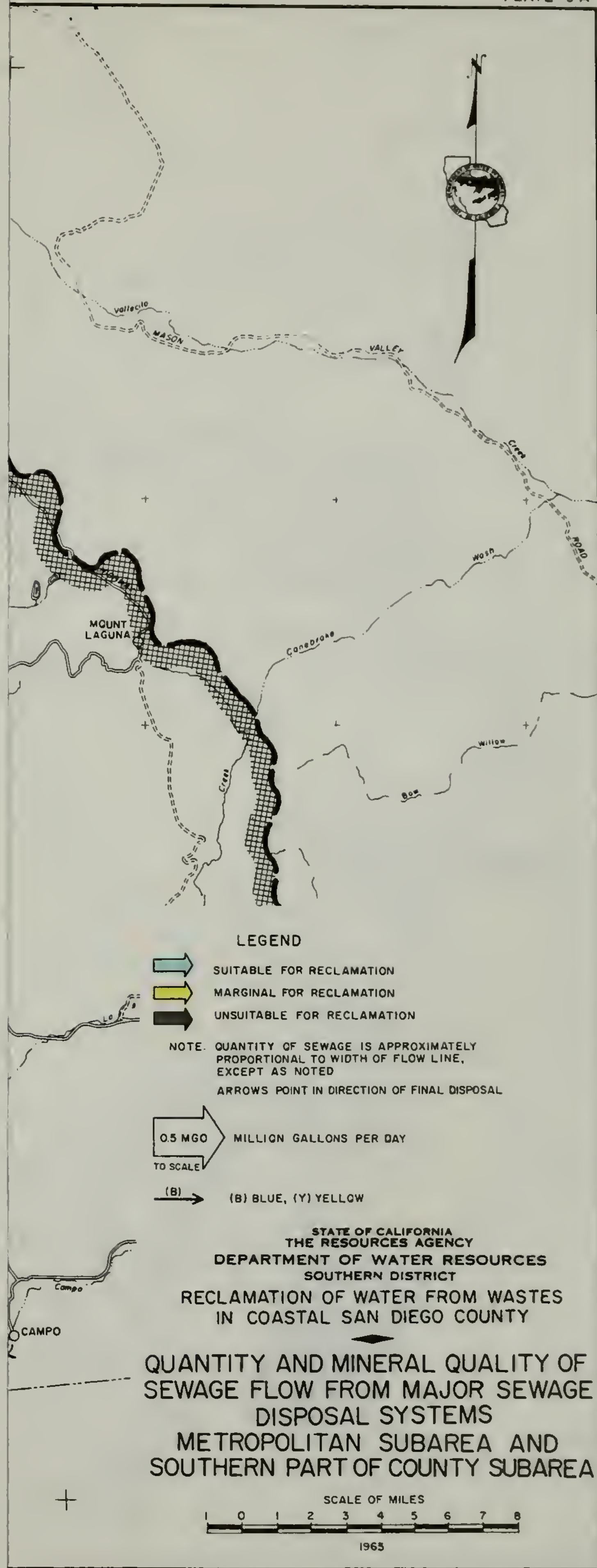
CABRILLO TRUNK SEWER

QUANTITY AND ELECTRICAL CONDUCTANCE
OF FLOWS IN
SAN DIEGO TRUNK SEWERS
DURING JULY 1962



QUANTITY AND ELECTRICAL CONDUCTANCE
OF FLOWS IN
SAN DIEGO TRUNK SEWERS
DURING JULY 1962

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1965



LEGEND

SUITABLE FOR RECLAMATION

MARGINAL FOR RECLAMATION

UNSUITABLE FOR RECLAMATION

NOTE. QUANTITY OF SEWAGE IS APPROXIMATELY PROPORTIONAL TO WIDTH OF FLOW LINE, EXCEPT AS NOTED

ARROWS POINT IN DIRECTION OF FINAL DISPOSAL

0.5 MGD TO SCALE — MILLION GALLONS PER DAY

(B) → (B) BLUE, (Y) YELLOW

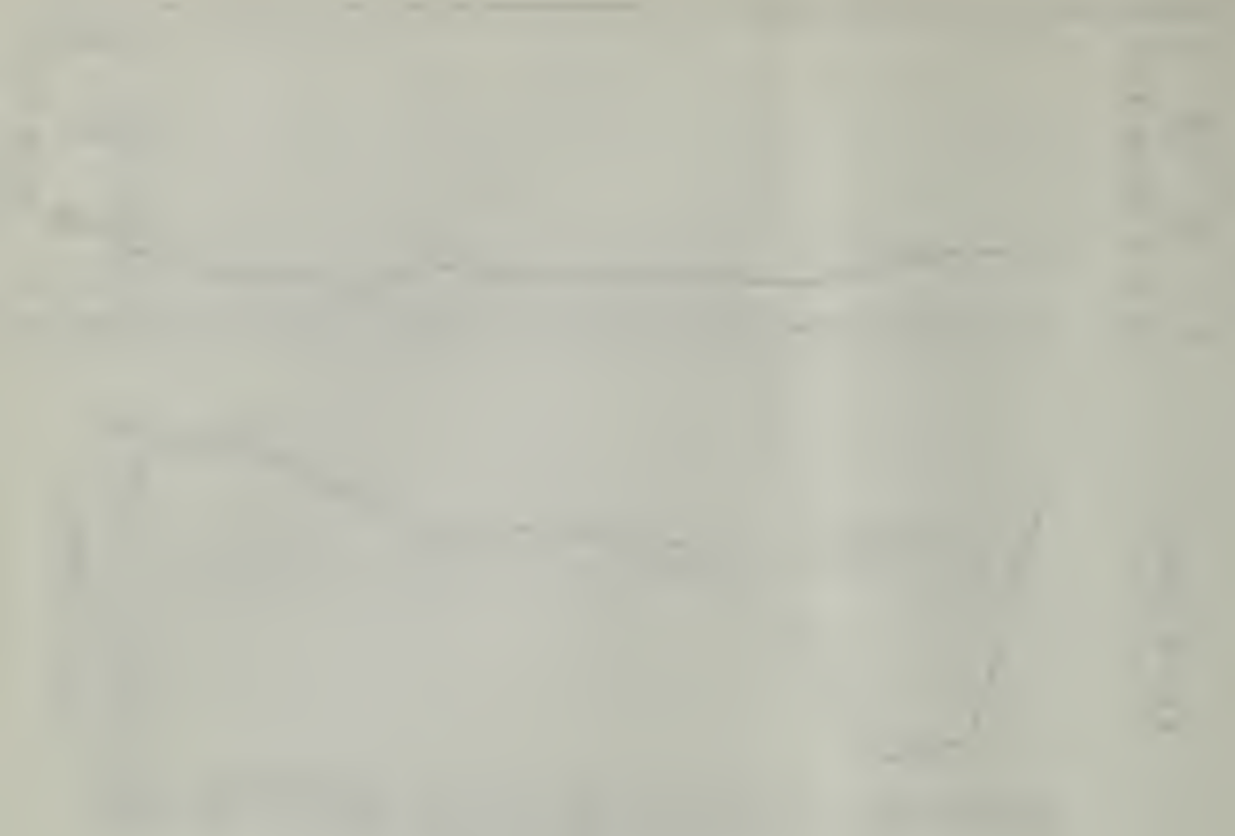
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

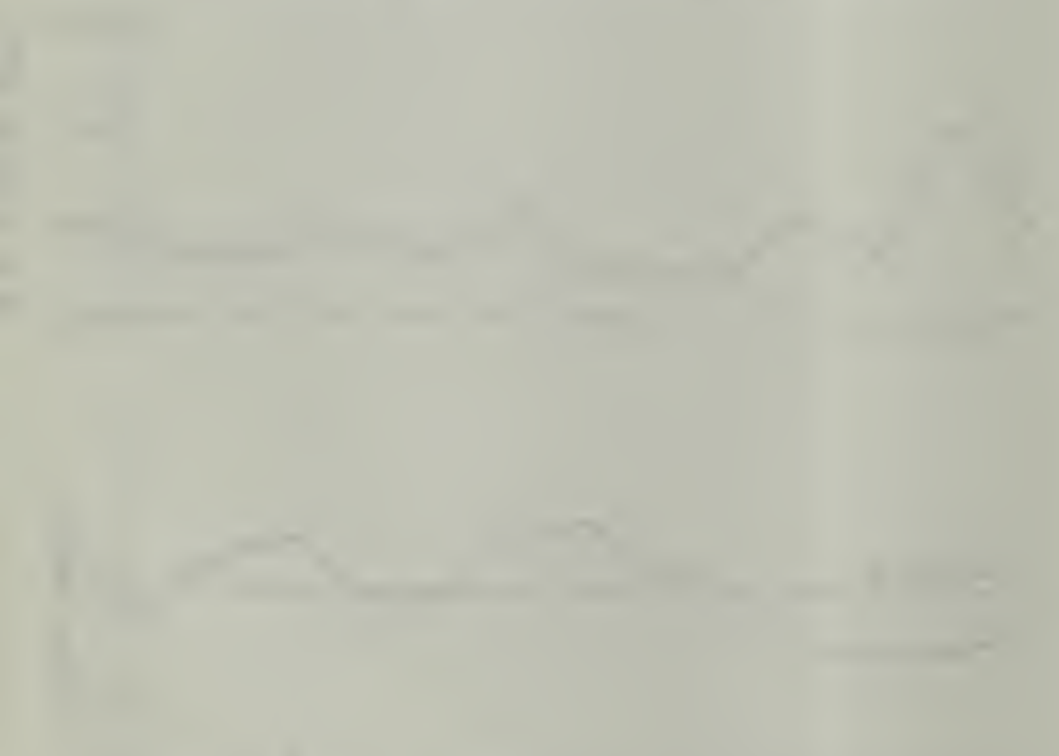
RECLAMATION OF WATER FROM WASTES IN COASTAL SAN DIEGO COUNTY

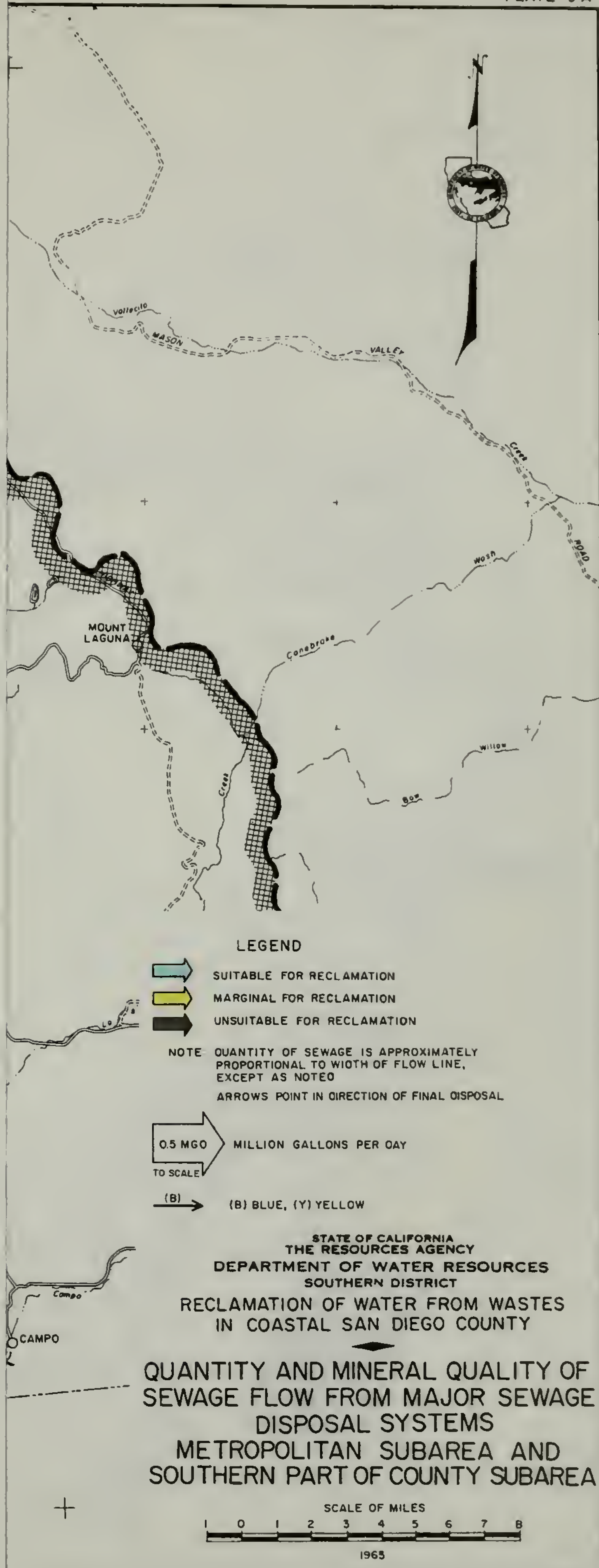
QUANTITY AND MINERAL QUALITY OF SEWAGE FLOW FROM MAJOR SEWAGE DISPOSAL SYSTEMS METROPOLITAN SUBAREA AND SOUTHERN PART OF COUNTY SUBAREA

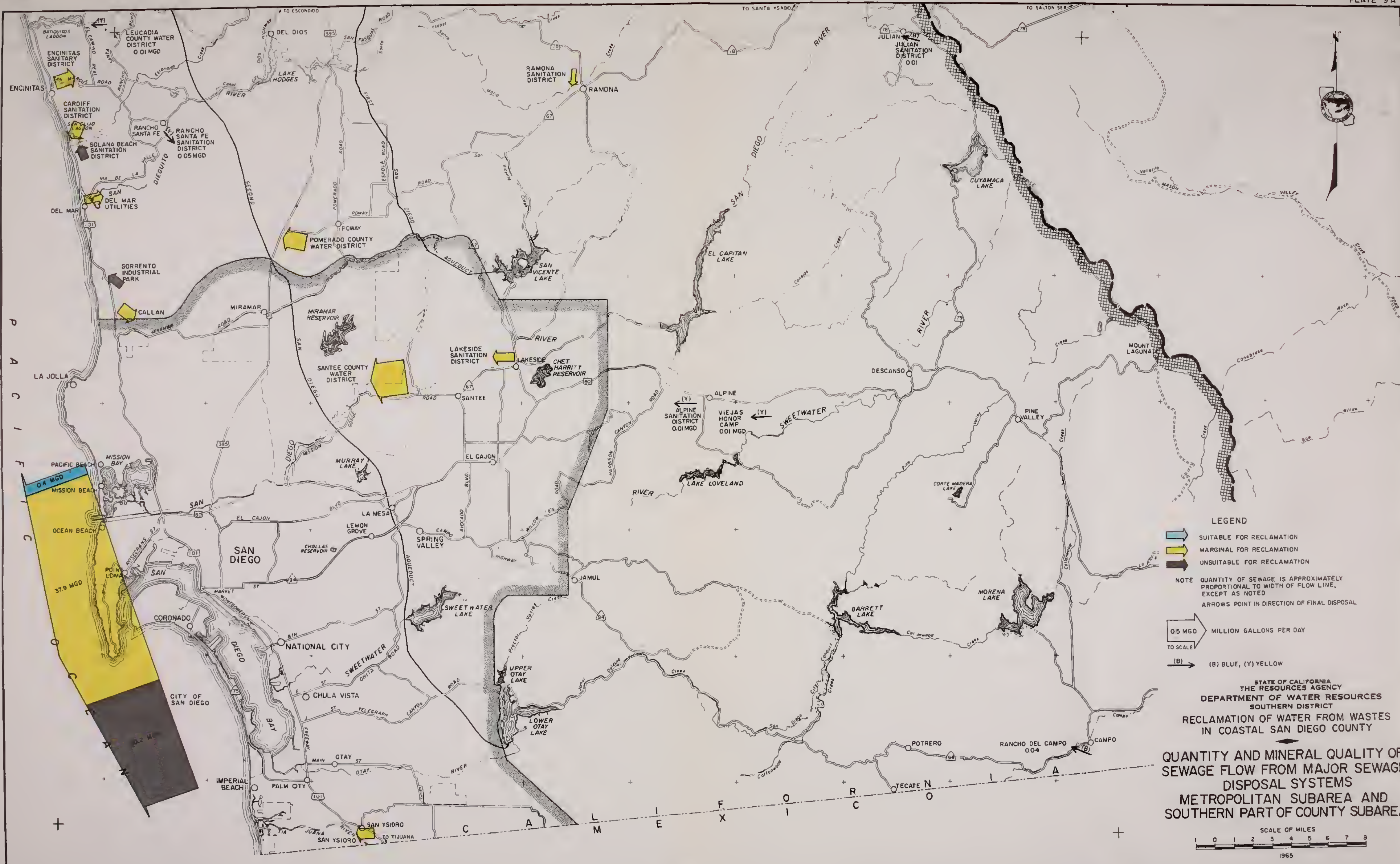
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8

1965






Vallecito
MASON
VALLEY
Creek
ROAD
Wash
Canebrake
MOUNT LAGUNA
Creek
Willow
Bow
Campo
CAMPO
LEGEND
SUITABLE FOR RECLAMATION
MARGINAL FOR RECLAMATION
UNSUITABLE FOR RECLAMATION
NOTE QUANTITY OF SEWAGE IS APPROXIMATELY PROPORTIONAL TO WIDTH OF FLOW LINE, EXCEPT AS NOTED
ARROWS POINT IN DIRECTION OF FINAL DISPOSAL
0.5 MGD MILLION GALLONS PER DAY
TO SCALE
(B) (B) BLUE, (Y) YELLOW
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES IN COASTAL SAN DIEGO COUNTY
QUANTITY AND MINERAL QUALITY OF SEWAGE FLOW FROM MAJOR SEWAGE DISPOSAL SYSTEMS
METROPOLITAN SUBAREA AND SOUTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1965



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES IN COASTAL SAN DIEGO COUNTY

QUANTITY AND MINERAL QUALITY OF SEWAGE FLOW FROM MAJOR SEWAGE DISPOSAL SYSTEMS METROPOLITAN SUBAREA AND SOUTHERN PART OF COUNTY SUBAREA

SCALE OF MILES
1 0 1 2 3 4 5 6 7 8

1965

PLATE 9B

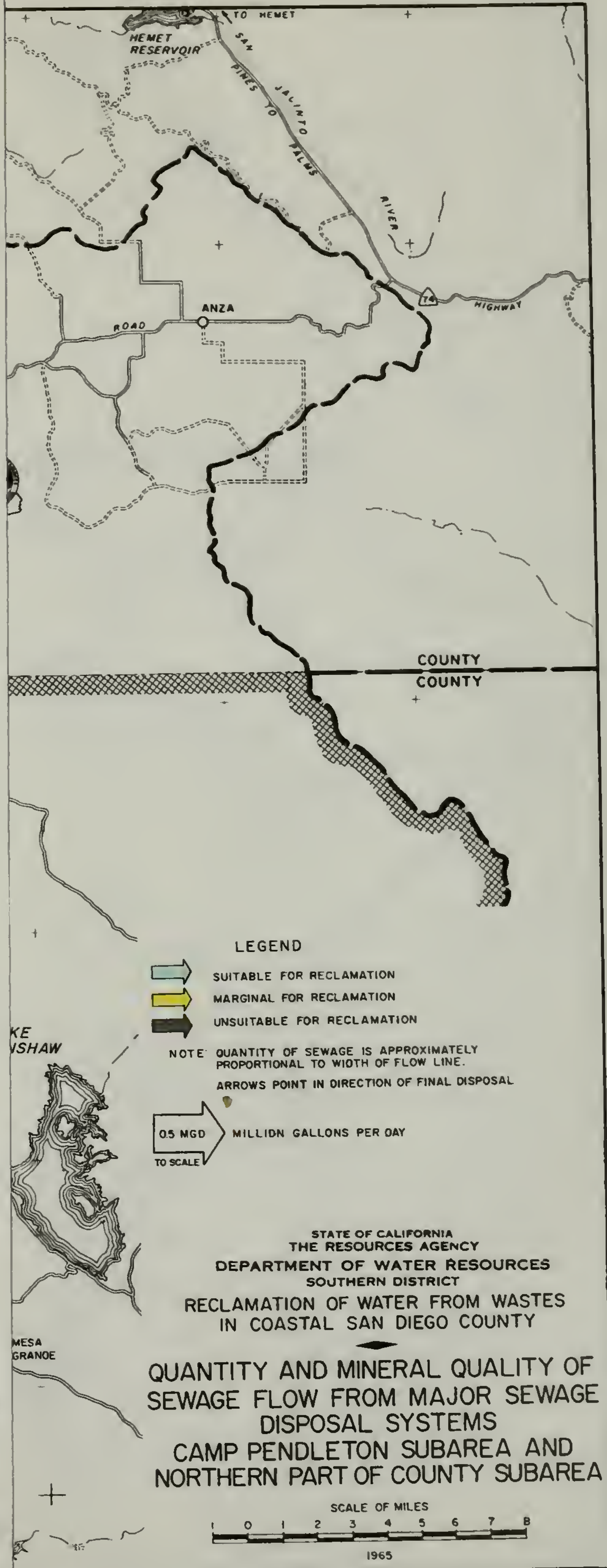
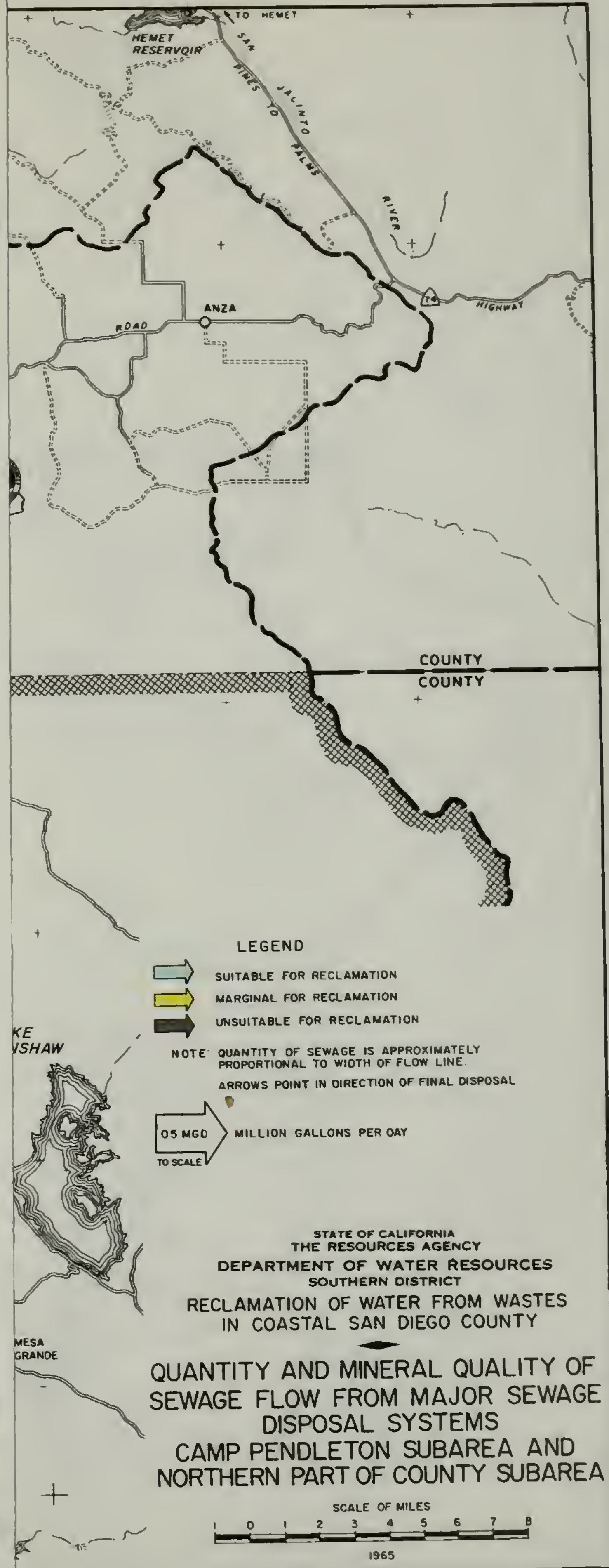
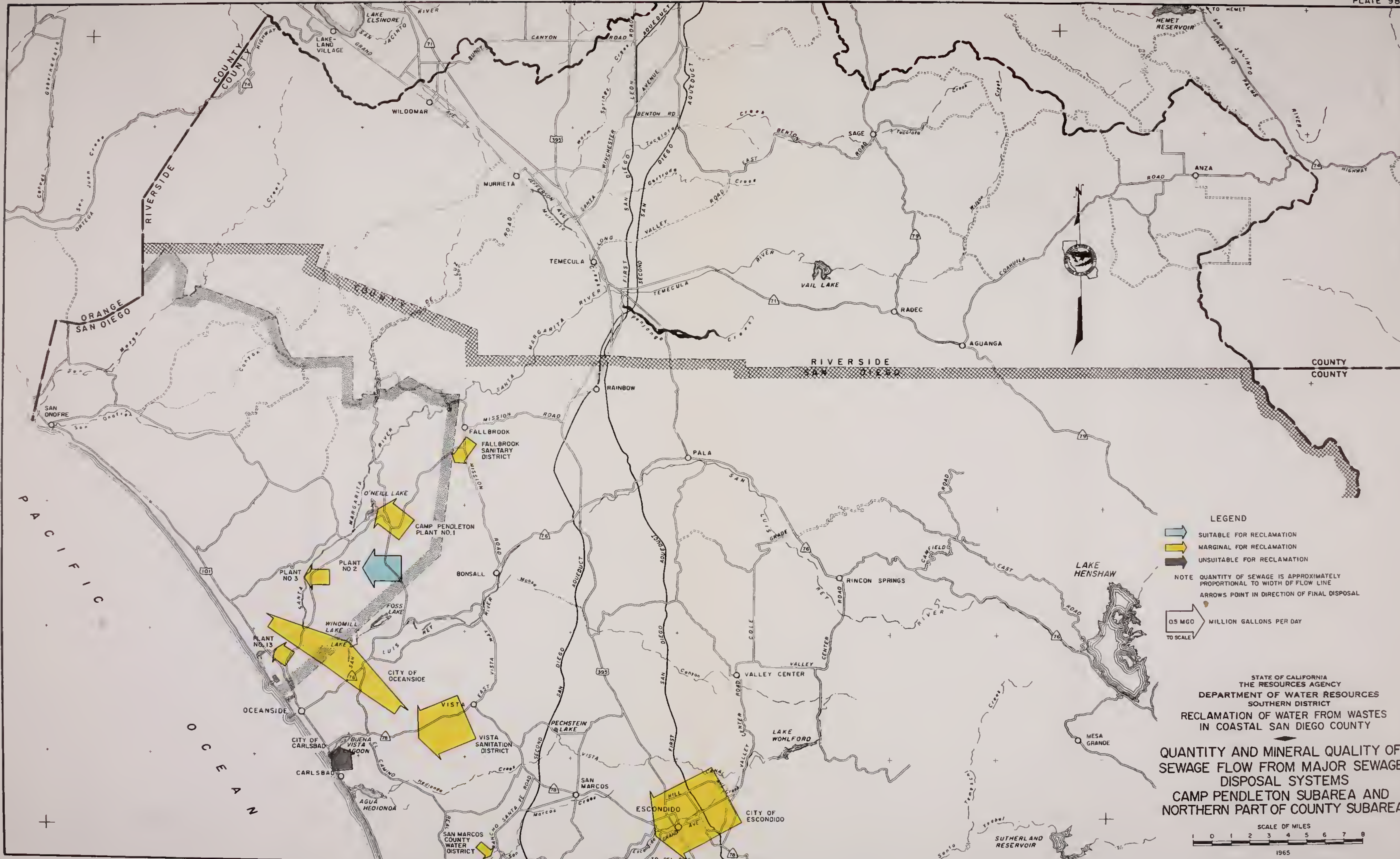

TO HEMET
HEMET RESERVOIR
SAN JACINTO
PINES TO PALMS
RIVER
74
HIGHWAY
ANZA
ROAD
COUNTY
COUNTY
KE
NSHAW
MESA
GRANDE
LEGEND
SUITABLE FOR RECLAMATION
MARGINAL FOR RECLAMATION
UNSUITABLE FOR RECLAMATION
NOTE: QUANTITY OF SEWAGE IS APPROXIMATELY PROPORTIONAL TO WIDTH OF FLOW LINE.
ARROWS POINT IN DIRECTION OF FINAL DISPOSAL
0.5 MGD
TO SCALE
MILLION GALLONS PER DAY
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
QUANTITY AND MINERAL QUALITY OF
SEWAGE FLOW FROM MAJOR SEWAGE
DISPOSAL SYSTEMS
CAMP PENDLETON SUBAREA AND
NORTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1965

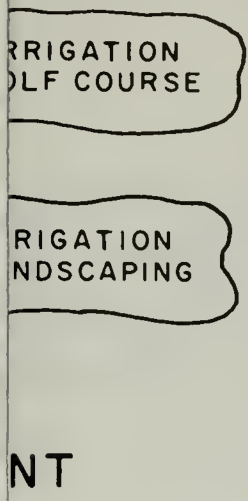
PLATE 9B



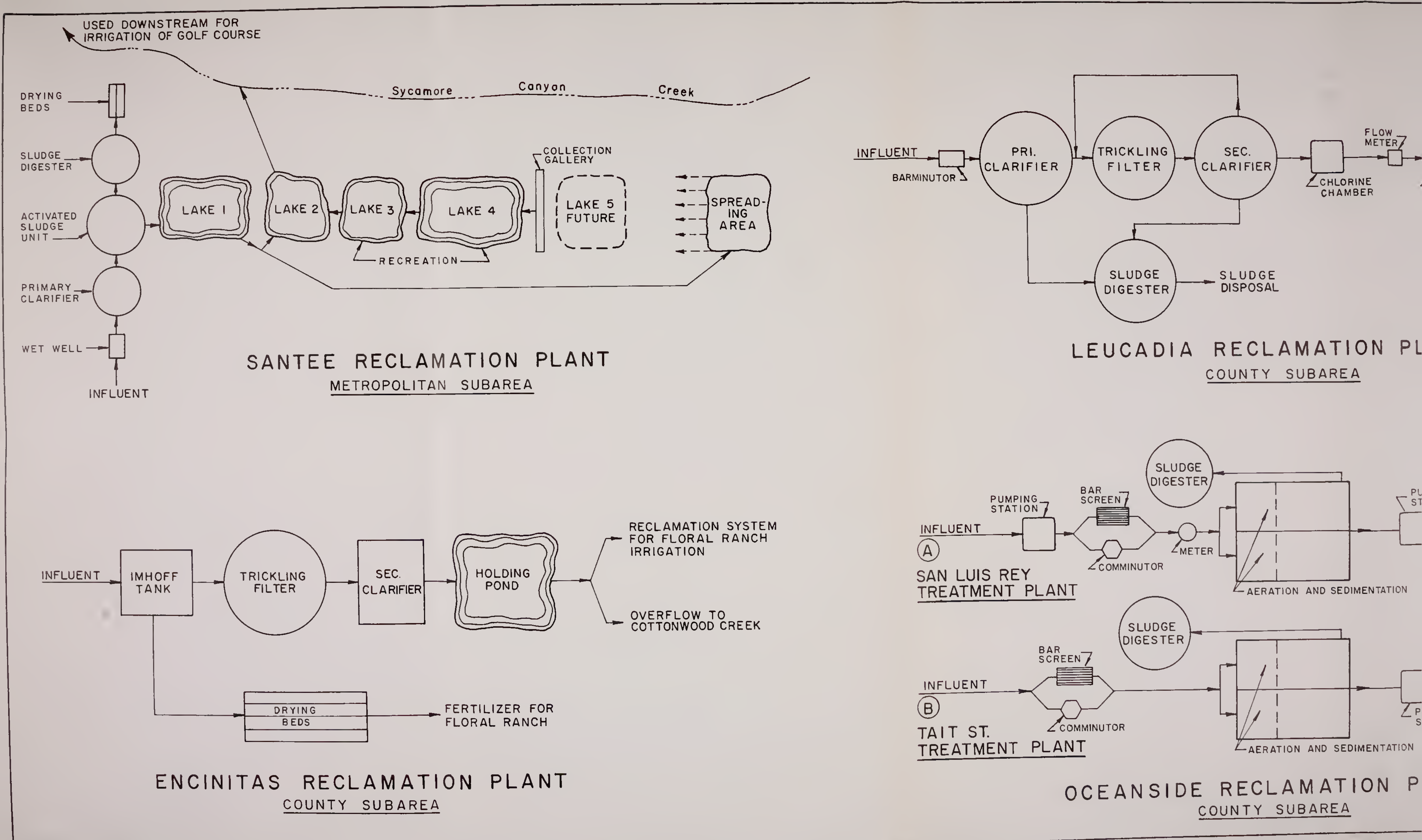
TO HEMET
HEMET RESERVOIR
SAN JACINTO RIVER
PINES TO PALMS
74
HIGHWAY
ANZA
ROAD
COUNTY
COUNTY
KE
SHAW
MESA GRANDE
LEGEND
SUITABLE FOR RECLAMATION
MARGINAL FOR RECLAMATION
UNSUITABLE FOR RECLAMATION
NOTE: QUANTITY OF SEWAGE IS APPROXIMATELY PROPORTIONAL TO WIDTH OF FLOW LINE.
ARROWS POINT IN DIRECTION OF FINAL DISPOSAL
0.5 MGD
TO SCALE
MILLION GALLONS PER DAY
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
QUANTITY AND MINERAL QUALITY OF
SEWAGE FLOW FROM MAJOR SEWAGE
DISPOSAL SYSTEMS
CAMP PENDLETON SUBAREA AND
NORTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1965


LEGEND
SUITABLE FOR RECLAMATION
MARGINAL FOR RECLAMATION
UNSUITABLE FOR RECLAMATION
NOTE QUANTITY OF SEWAGE IS APPROXIMATELY PROPORTIONAL TO WIDTH OF FLOW LINE
ARROWS POINT IN DIRECTION OF FINAL DISPOSAL
0.5 MGD
MILLION GALLONS PER DAY
TO SCALE
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
QUANTITY AND MINERAL QUALITY OF
SEWAGE FLOW FROM MAJOR SEWAGE
DISPOSAL SYSTEMS
CAMP PENDLETON SUBAREA AND
NORTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1965
PACIFIC OCEAN
RIVERSIDE COUNTY
SAN DIEGO COUNTY
ORANGE
SAN DIEGO
LAKE ELSINORE
LAKE-LAND VILLAGE
WILDOMAR
MURRIETA
TEMECULA
RAINBOW
FALLBROOK
FALLBROOK SANITARY DISTRICT
O'NEILL LAKE
CAMP PENDLETON PLANT NO.1
PLANT NO 2
PLANT NO 3
PLANT NO.13
WINDMILL LAKE
FOSS LAKE
BONSALL
CITY OF OCEANSIDE
OCEANSIDE
VISTA
VISTA SANITATION DISTRICT
CITY OF CARLSBAD
BUENA VISTA LAGOON
CARLSBAD
AGUA HEDIONDA
SAN MARCOS COUNTY WATER DISTRICT
SAN MARCOS
PECHSTEIN LAKE
ESCONDIDO
CITY OF ESCONDIDO
TO DEL DIOS
VALLEY CENTER
LAKE WOHLFORD
PALA
RINCON SPRINGS
LAKE HENSHAW
MESA GRANDE
SUTHERLAND RESERVOIR
SAN ONOFRE
SAGE
ANZA
RADEC
AGUANGA
VAIL LAKE
HEMET RESERVOIR
TO HEMET

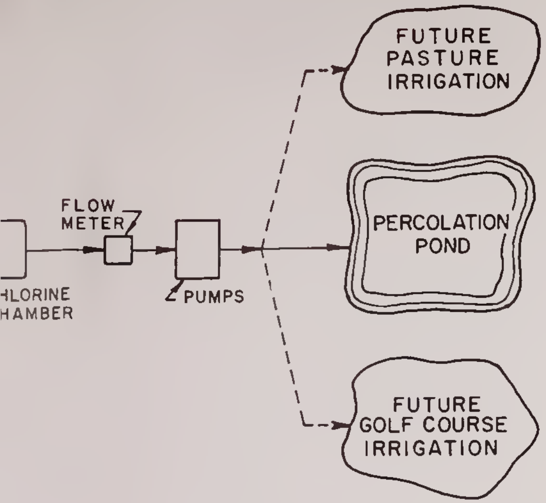
FLOW DIAGRAMS FOR EXISTING CLASS B
PLANNED WASTE WATER
RECLAMATION PLANTS IN THE
METROPOLITAN AND COUNTY SUBAREAS



FLOW DIAGRAMS FOR EXISTING CLASS B
PLANNED WASTE WATER
RECLAMATION PLANTS IN THE
METROPOLITAN AND COUNTY SUBAREAS

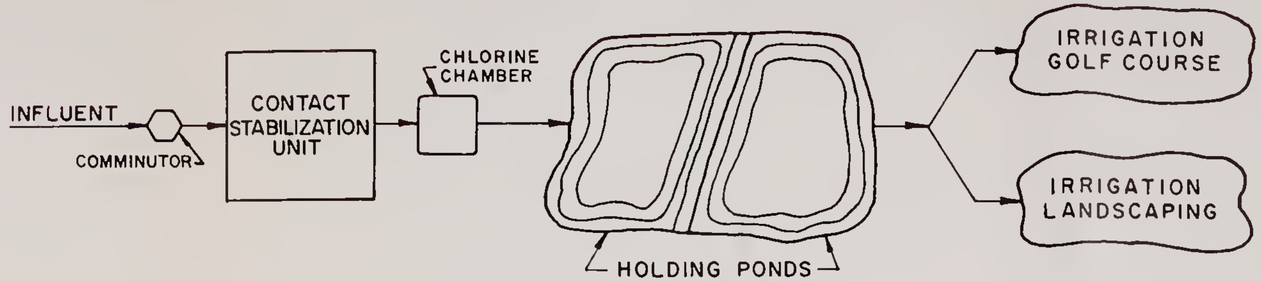


DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1965



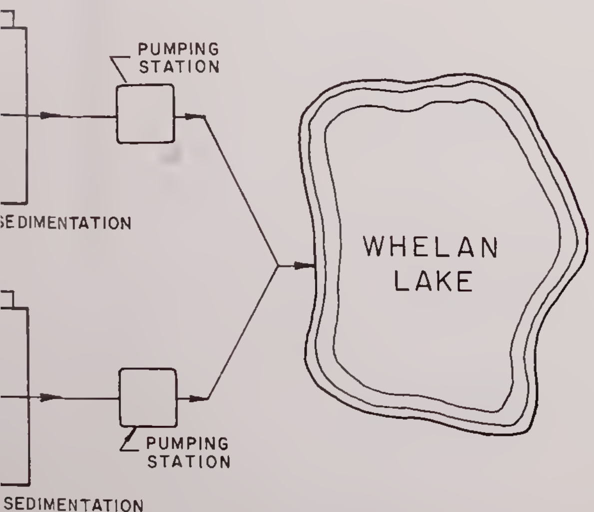
TION PLANT

REA



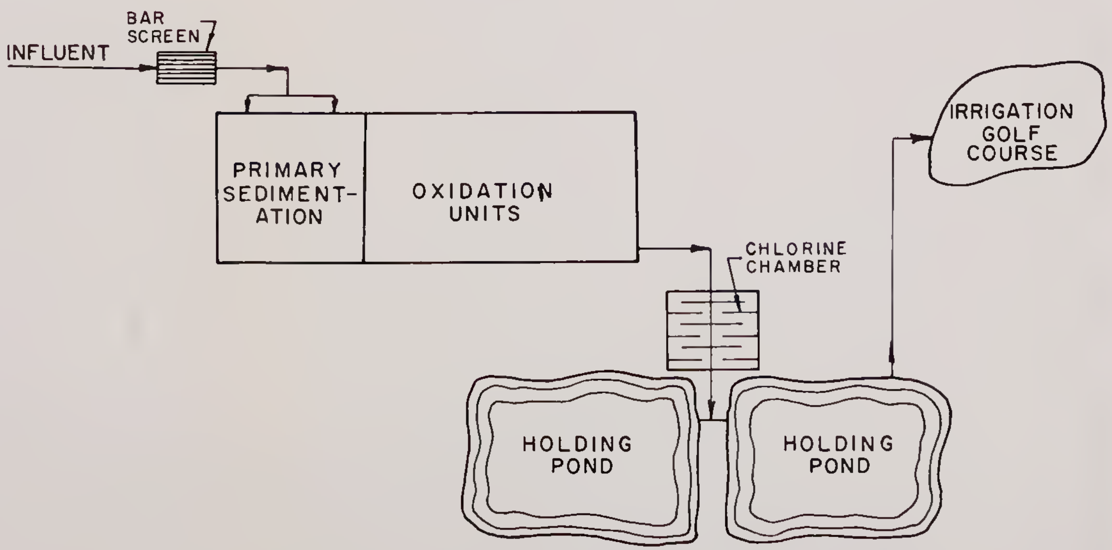
RANCHO BERNARDO – RECLAMATION PLANT

COUNTY SUBAREA



TION PLANT

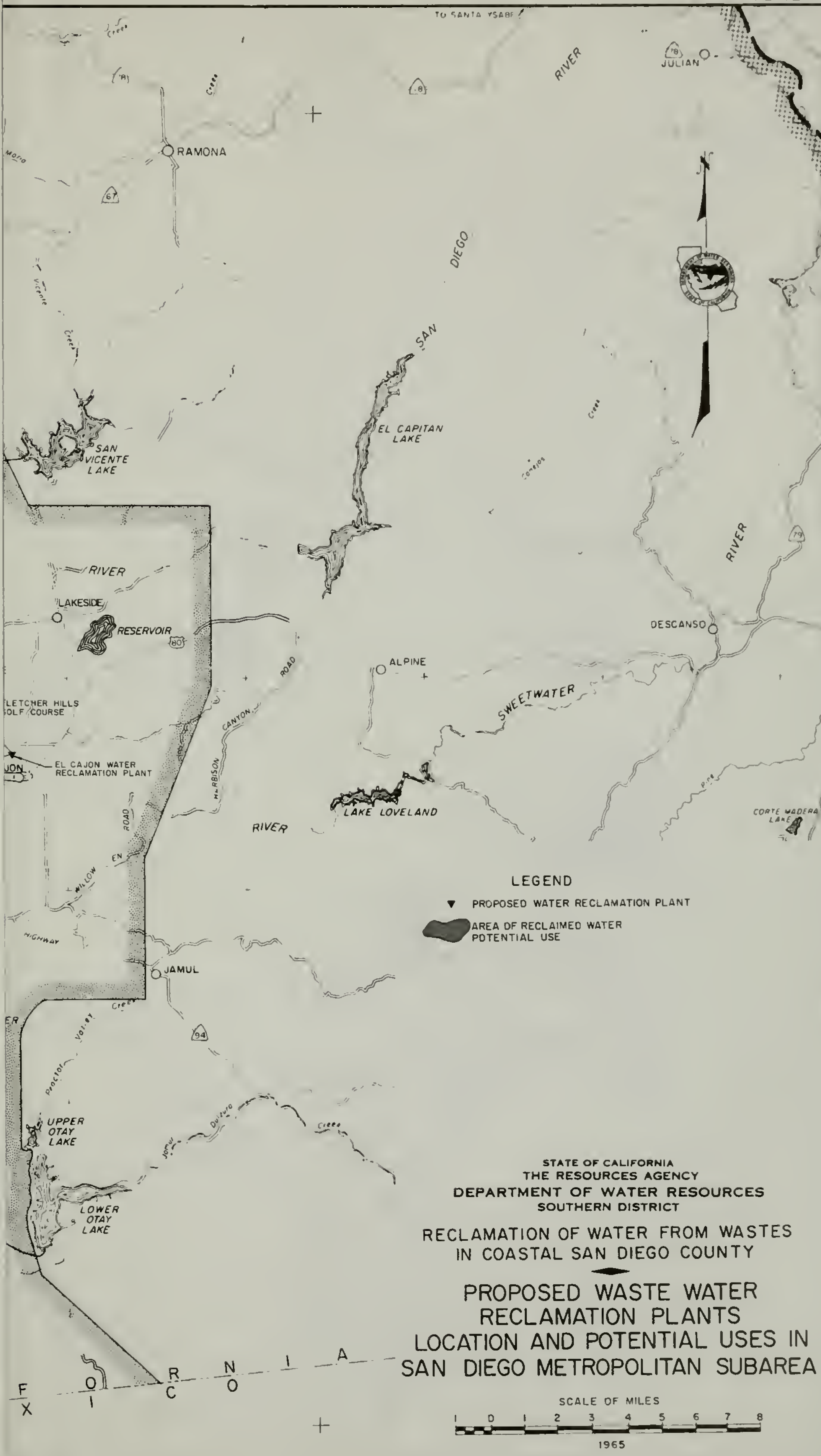
EA

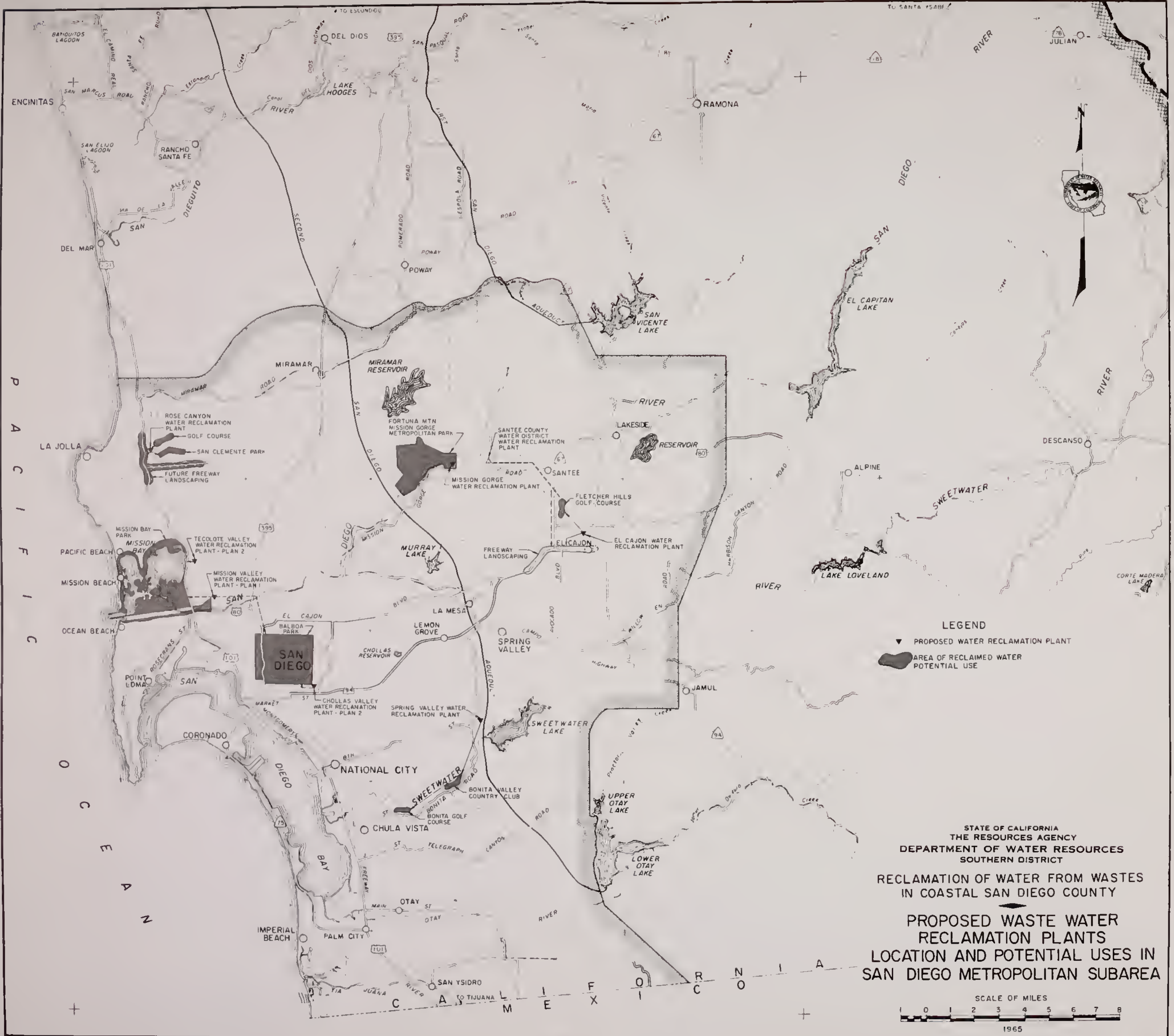


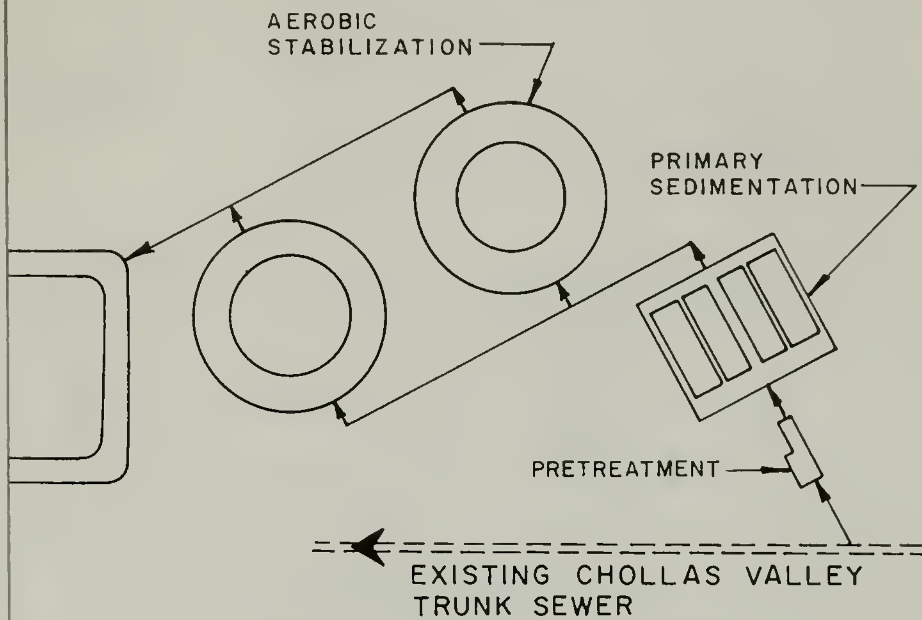
VALLE VERDE RECLAMATION PLAN

COUNTY SUBAREA

FLOW DIAGRAMS FOR EXISTING CLASS B
PLANNED WASTE WATER
RECLAMATION PLANTS IN THE
METROPOLITAN AND COUNTY SUBAREAS

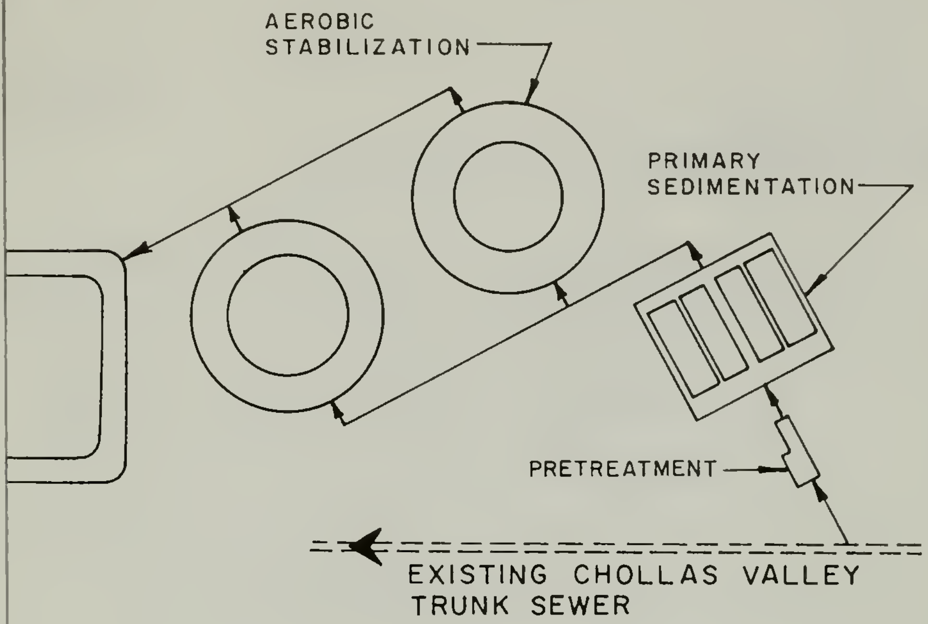

TO SANTA YSABEL
JULIAN
RIVER
RAMONA
SAN DIEGO
SAN VICENTE LAKE
EL CAPITAN LAKE
RIVER
LAKESIDE
RESERVOIR
FLETCHER HILLS GOLF COURSE
EL CAJON WATER RECLAMATION PLANT
HARBISON CANYON ROAD
DESCANSO
ALPINE
SWEETWATER
RIVER
LAKE LOVELAND
CORTE MADERA LAKE
RIVER
LEGEND
PROPOSED WATER RECLAMATION PLANT
AREA OF RECLAIMED WATER POTENTIAL USE
JAMUL
UPPER OTAY LAKE
LOWER OTAY LAKE
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES IN COASTAL SAN DIEGO COUNTY
PROPOSED WASTE WATER RECLAMATION PLANTS LOCATION AND POTENTIAL USES IN SAN DIEGO METROPOLITAN SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1965
CALIFORNIA
MEXICO


STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
PROPOSED WASTE WATER
RECLAMATION PLANTS
LOCATION AND POTENTIAL USES IN
SAN DIEGO METROPOLITAN SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1965
LEGEND
PROPOSED WATER RECLAMATION PLANT
AREA OF RECLAIMED WATER POTENTIAL USE
PACIFIC OCEAN
CALIFORNIA
MEXICO
ENCINITAS
DEL DIOS
LAKE HOGGES
RAMONA
JULIAN
RANCHO SANTA FE
DEL MAR
POWAY
MIRAMAR
MIRAMAR RESERVOIR
SAN VICENTE LAKE
EL CAPITAN LAKE
LA JOLLA
ROSE CANYON WATER RECLAMATION PLANT
GOLF COURSE
SAN CLEMENTE PARK
FUTURE FREEWAY LANDSCAPING
FORTUNA MTN MISSION GORGE METROPOLITAN PARK
MISSION GORGE WATER RECLAMATION PLANT
SANTEE COUNTY WATER DISTRICT WATER RECLAMATION PLANT
SANTEE
LAKESIDE
RESERVOIR
FLETCHER HILLS GOLF COURSE
EL CAJON
EL CAJON WATER RECLAMATION PLANT
FREEWAY LANDSCAPING
DESCANSO
ALPINE
MISSION BAY PARK
TECOLOTE VALLEY WATER RECLAMATION PLANT - PLAN 2
MISSION VALLEY WATER RECLAMATION PLANT - PLAN 1
PACIFIC BEACH
MISSION BEACH
OCEAN BEACH
MURRAY LAKE
LA MESA
LEMON GROVE
SPRING VALLEY
LAKE LOVELAND
CORTE MADERA LAKE
BALBOA PARK
SAN DIEGO
CHOLLAS RESERVOIR
CHOLLAS VALLEY WATER RECLAMATION PLANT - PLAN 2
SPRING VALLEY WATER RECLAMATION PLANT
POINT LOMA
CORONADO
SWEETWATER LAKE
JAMUL
NATIONAL CITY
BONITA VALLEY COUNTRY CLUB
BONITA GOLF COURSE
CHULA VISTA
UPPER OTAY LAKE
LOWER OTAY LAKE
OTAY
IMPERIAL BEACH
PALM CITY
SAN YSIDRO
TO TIJUANA



VALLEY RECLAMATION PLANT
PLAN 2

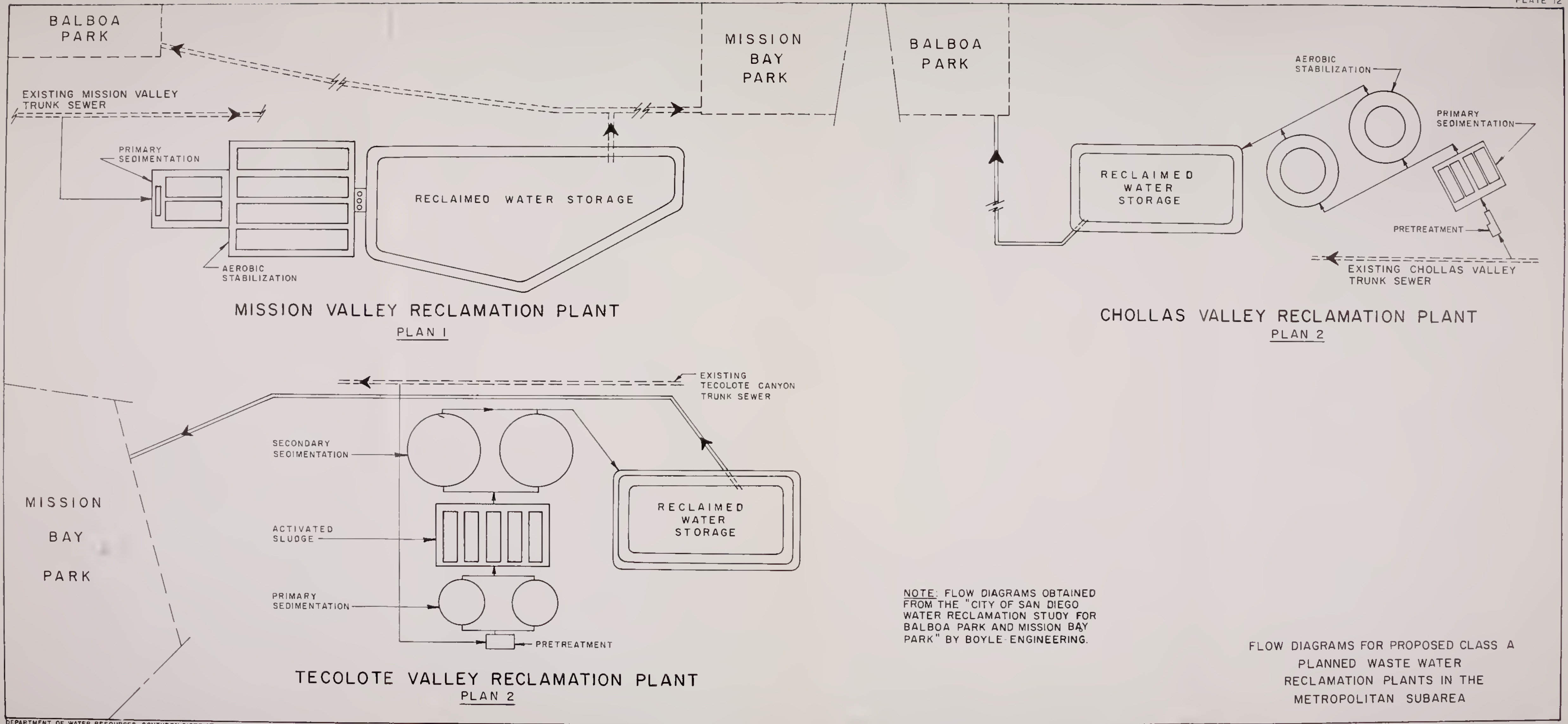
FLOW DIAGRAMS FOR PROPOSED CLASS A
PLANNED WASTE WATER
RECLAMATION PLANTS IN THE
METROPOLITAN SUBAREA



VALLEY RECLAMATION PLANT

PLAN 2

FLOW DIAGRAMS FOR PROPOSED CLASS A
PLANNED WASTE WATER
RECLAMATION PLANTS IN THE
METROPOLITAN SUBAREA



NOTE: FLOW DIAGRAMS OBTAINED FROM THE "CITY OF SAN DIEGO WATER RECLAMATION STUDY FOR BALBOA PARK AND MISSION BAY PARK" BY BOYLE ENGINEERING.

FLOW DIAGRAMS FOR PROPOSED CLASS A PLANNED WASTE WATER RECLAMATION PLANTS IN THE METROPOLITAN SUBAREA

NOTE: EXISTING TRUNK SEWERS ARE CONNECTED TO THE SAN DIEGO METROPOLITAN SEWERAGE SYSTEM WITH FINAL TREATMENT AND DISPOSAL AT THE POINT LOMA SEWAGE TREATMENT PLANT.

ON

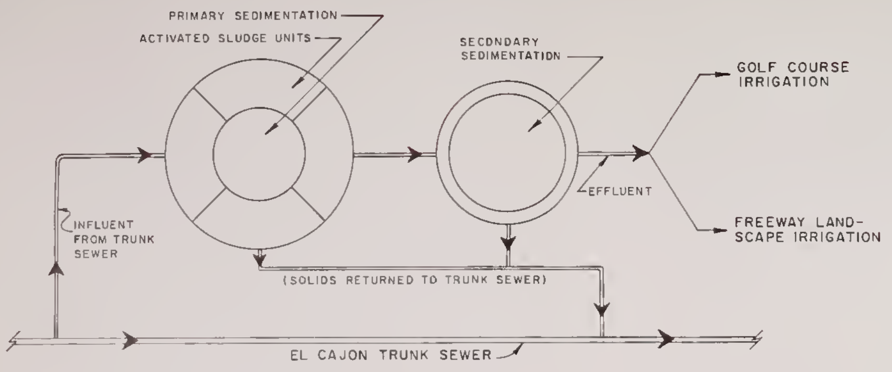
FLOW DIAGRAMS FOR POTENTIAL CLASS A PLANNED WASTE WATER RECLAMATION PLANTS IN THE METROPOLITAN SUBAREA

NOTE: EXISTING TRUNK SEWERS ARE CONNECTED TO THE SAN DIEGO METROPOLITAN SEWERAGE SYSTEM WITH FINAL TREATMENT AND DISPOSAL AT THE POINT LOMA SEWAGE TREATMENT PLANT.

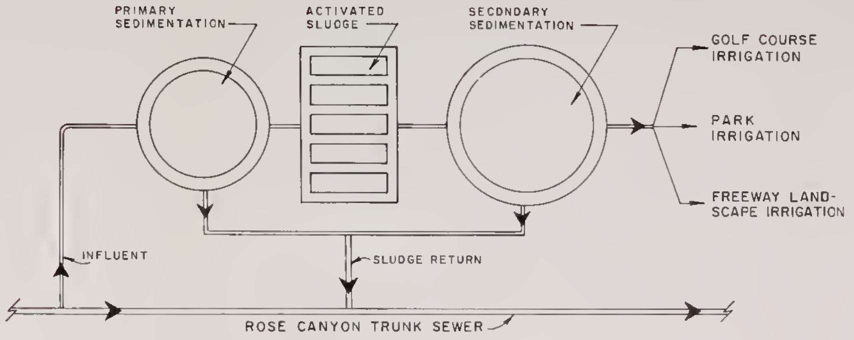
ON

FLOW DIAGRAMS FOR POTENTIAL CLASS A
PLANNED WASTE WATER
RECLAMATION PLANTS IN THE
METROPOLITAN SUBAREA

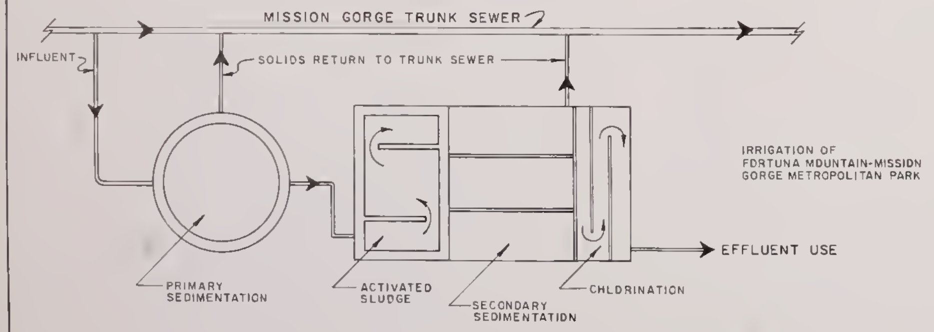
NOTE EXISTING TRUNK SEWERS ARE CONNECTED TO THE SAN DIEGO METROPOLITAN SEWERAGE SYSTEM WITH FINAL TREATMENT AND DISPOSAL AT THE POINT LOMA SEWAGE TREATMENT PLANT



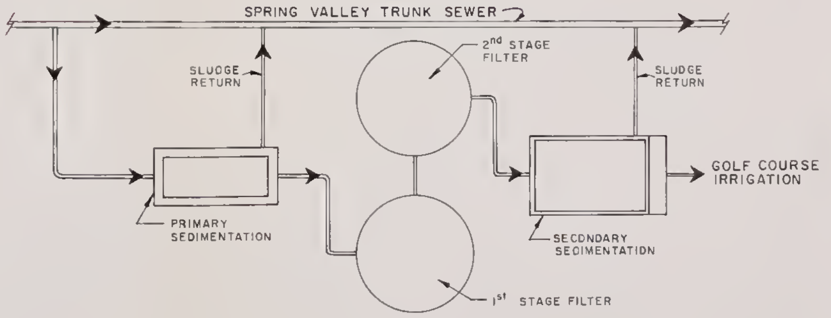
EL CAJON WATER RECLAMATION PLANT



ROSE CANYON WATER RECLAMATION PLANT



MISSION GORGE WATER RECLAMATION PLANT



SPRING VALLEY WATER RECLAMATION PLANT

FLOW DIAGRAMS FOR POTENTIAL CLASS A PLANNED WASTE WATER RECLAMATION PLANTS IN THE METROPOLITAN SUBAREA